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Preliminary results from the groundfish and shrimp multidisciplinary survey in August 2015 in the Estuary and northern Gulf of St. Lawrence

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Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Research documents are produced in the official language in which they are provided to the Secretariat.

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ABSTRACT

The Department of Fisheries and Oceans conducts an annual multidisciplinary survey in the Estuary and northern Gulf of St. Lawrence. The objectives of this survey are quite varied: assess the biodiversity of the species near the floor, estimate the abundance of groundfish and invertebrates, assess physical and biological oceanographic conditions (phytoplankton and zooplankton), monitor the pelagic ecosystem, take an inventory of marine mammal and seabird, and collect samples for various research projects. In 2015, the survey was conducted between August 1 and September 2 on board the *CCGS Teleost*. During this survey, 190 trawl tows were successful as well as 133 CTD casts of the water column and 91 zooplankton samples.

This report presents the results from catches from the 190 tows. In total, 84 fish taxa and 196 invertebrate taxa were identified during the mission. Historical perspectives (catch rates, spatial distribution and length frequency) are presented for about 20 taxa. These commercial fishery-independent data will be used in several stock assessments (e.g., cod, redfish, Greenland Halibut, Atlantic Halibut and Northern Shrimp). For these species, abundance and biomass indicators in 2015 are comparable to the average or show upward trends, especially for small redfish.

Preliminary data analysis for water temperature measured in 2015 shows very hot conditions in deep water (150 m and more), but near normal condition for the cold intermediate layer and the summer surface water.

RÉSUMÉ

Le Ministère des Pêches et des Océans réalise annuellement un relevé multidisciplinaire dans l'estuaire et le nord du golfe du Saint-Laurent. Les objectifs de ce relevé sont multiples : évaluer la biodiversité des espèces présentes près du fond; estimer l'abondance des poissons de fonds et des invertébrés; évaluer les conditions océanographiques physiques et biologiques (phytoplancton et zooplancton); monitorer l'écosystème pélagique; inventorier les mammifères et les oiseaux marins; et récolter des échantillons pour divers projets de recherche. En 2015, le relevé s'est déroulé du 1er août au 2 septembre, à bord du *NGCC Teleost*. Lors de cette mission, 190 traits de chalut ont été réussis ainsi que 133 profils verticaux de la colonne d'eau afin de caractériser les conditions océanographies et 91 échantillons de zooplancton.

Ce rapport présente les résultats des captures des 190 traits de chalut. Au total, 84 taxons de poissons et 196 taxons d'invertébrés ont été identifiés lors de la mission. Les perspectives historiques (taux de capture, répartition spatiale, fréquence de longueur) sont présentées pour une vingtaine de taxons. Ces données indépendantes de la pêche commerciale serviront à plusieurs évaluations de stocks, dont la morue, les sébastes, le flétan du Groenland, le flétan atlantique et la crevette nordique. Pour ces espèces, les indices d'abondance et de biomasse en 2015 sont soit comparables à la moyenne ou montrent des tendances à l'augmentation, particulièrement pour les petits sébastes.

L'analyse préliminaire des données de température de l'eau mesurée en 2015 montre des conditions très chaudes dans les eaux profondes (150 m et plus), mais près de la normale en ce qui concerne la couche intermédiaire froide ainsi que les eaux de surface estivales.

INTRODUCTION

The Department of Fisheries and Oceans conducts an annual bottom trawl survey in the Estuary and the northern Gulf of St. Lawrence. This is a multi-species, commercial fishery-independent survey. Its purpose is to assess the ecosystem with consistent, standardized protocols to examine the spatial and temporal changes in 1) the distribution, relative abundance and assemblage of fish, and 2) commercial species' biological parameters.

The main objectives are to:

1. assess groundfish and Northern Shrimp population abundance and condition;
2. assess environmental conditions;
3. take a biodiversity inventory;
4. assess phytoplankton and mesozooplankton abundance;
5. monitor the pelagic ecosystem;
6. take a marine mammal inventory;
7. take a seabird inventory;
8. collect samples for various research projects.

In 2015, the survey was conducted between August 1 and September 2 on board the *CCGS Teleost* (mission #IML-2015-031).

SURVEY DESCRIPTION

The survey covers the waters of the Laurentian Channel and north of it, from the Lower Estuary in the west to the Strait of Belle Isle and the Cabot Strait in the east, namely, the Northwest Atlantic Fisheries Organization (NAFO) divisions 4R, 4S and the northern part of 4T (Figure 1). Since 2008, coverage of division 4T has been increased in the upstream part of the Lower Estuary in order to sample the depths between 37 and 183 m. The area of the study area is 118,587 km^2.

A stratified random sampling strategy is used for this survey. This technique consists in subdividing the study area into more homogeneous strata. This area is divided into 54 strata, which were divided based on depth, NAFO division and substrate type (Figure 2). A total of 200 trawl stations was initially allocated in the study area, a number proportional to the stratum surface, with a minimum of two stations per stratum. The tow positions were chosen randomly within each stratum. Since 2014, a new rules was added to respect a minimum distance of 10 km between stations in the same stratum.

The fishing gear used on the *CCGS Teleost* is a four-sided Campelen 1800 shrimp trawl equipped with a Rockhopper footgear ("bicycle") (McCallum and Walsh 2002). The trawl lengthening and codend are equipped with a 12.7-mm knotless nylon lining. Standard trawling tows last 15 minutes, starting from the time the trawl touched the sea floor as determined by the *Scanmar*™ hydroacoustic system. Towing speed is 3 knots. Information on trawl geometry (horizontal spread of the doors and wings, vertical opening of the trawl, depth) was recorded for each tow using *Scanmar*™ hydroacoustic sensors mounted on the fishing gear.

In 2015, 190 fishing stations were successful, 58 in 4R, 84 in 4S and 48 in 4T (Appendix 1). Coverage of the study area was very good; all strata were covered with a minimum of two stations (Figure 3).

For each fishing tow, the catch was sorted and weighed by taxa; biological data were then collected. For fish, crab and squid, size and weight are gathered by individual and, for some species, sex, gonad maturity, and the weight of certain organs (stomach, liver, gonads) are also

evaluated. Count of soft rays of the anal fin for Redfish, and otoliths are saved for cod, Atlantic Halibut and Witch Flounder. A roughly 2-kg shrimp sample is sorted and weighed by species (and by stage of maturity for Northern Shrimp). The shrimp are measured individually. The other invertebrates are counted (no individual measurements) and photographed. The photos are archived in a photo catalogue with keywords (station description, scientific name, etc.).

In recent years, efforts to better describe catches of non-commercial species have intensified. Efforts were increased in 2003 for fish and in 2006 for invertebrates. An identification guide for marine fishes of the estuary and northern Gulf of St. Lawrence (Nozères et al, 2010) and a guide for invertebrates (Nozères et al, 2014) were used to identify most taxa at the species level.

Additional samples were taken for various scientific projects. These samples include:

1. Specimens were collected to verify identification (Lantern fishes, eelpouts, unemaks, Arctic Alligatorfish and lumpfishes) and added to the permanent collection at the Maurice Lamontagne Institute (MLI);
2. Boxes of shrimp and capelin for requests for aquaculture purposes from the MLI tank room;
3. Black Dogfish embryos and juveniles, and ray capsules in order to study their developmental morphology and their chondrification and mineralization processes;
4. Invasive species (tunicates) to confirm their genetic and microscopic identification;
5. Fish stomachs (Black Dogfish, Atlantic Halibut, Greenland Halibut, Lumpfish, Cod, Redfish) and squid (Short-fin Squid) to enhance knowledge of their diet;
6. Silver Hake studied for its trophic role, growth and origin;
7. Small redfish (< 11 cm) for genetic identification of the species (*Sebastes fasciatus* or *S. mentella*) and the population of new cohorts observed in the Gulf;
8. Sea pens (4 species) collected to study their reproduction and pathologies;
9. Marine mammal prey (several fish species and Northern Shrimp) to follow the development of St. Lawrence ecosystem key species' isotropic signatures;.

Oceanographic conditions such as temperature, conductivity (salinity), pH, dissolved oxygen, luminosity and fluorescence were sampled during this survey. A total of 133 vertical profiles of the water column were done, nineteen of which were at extra stations that fall under the Atlantic Zone Monitoring Program (AZMP). The various equipment, *CTD SeaBird 911Plus*™, dissolved oxygen sensor (*SBE 43*), *WETStar*™ photometer and fluorometer, are coupled to the rosette of Niskin bottles. For each profile obtained using the rosette, water samples are also taken at predetermined depths to determine their salinity, dissolved oxygen concentration (Winkler titration), nutritive salt content (nitrite, nitrate, phosphate, silicate) and chlorophyll content. In addition, a *CTD SBE 19Plus*™ device, coupled to a dissolved oxygen sensor (*Aanderaa* optode) and a *WETStar*™ photometer and fluorometer, was also installed on the back of the trawl, thereby allowing oceanographic data to be collected for the 190 fishing tows.

To study zooplankton distribution and biomass for the entire territory covered by the survey, a sampling program component consisted in using a zooplankton net (202 µm), pulled vertically from the floor to the surface at 91 stations.

Continuously throughout the mission, water column hydroacoustic data at four frequencies (38, 70, 120 and 200 kHz) were recorded using a *SIMRAD*™ *EK60* echosounder. These data will be used to develop a three-dimensional database to map the pelagic ecosystem.

A marine mammal and seabird inventory in the study area was taken by two observers stationed at the front of the bridge when conditions permitted.

DATA ANALYSIS

The analysis of 2015 abundance and biomass data were integrated into the combined annual summer survey series initiated in 1990. This combined series was developed following a comparative study between the two vessel-gear tandems (1990-2005: *CCGS Alfred Needler – URI 81'/114'* trawl; 2004-2012: *CCGS Teleost – Campelen 1800* trawl) to establish specific correction factors for about twenty species caught (Bourdages *et al.* 2007). This resulted in adjustment of *Needler* catches into *Teleost* equivalent catches.

Given that over the years, some strata were not sampled by a minimum of two successful tows (Appendix 1), a multiplicative model was used to estimate their catch rate indexes in number and weight. This model provides a predicted value for strata with less than two tows with the data of the current year and the previous three years. Thus, indicators presented for the series are representative of a standard total area 116 115 km^2, the sum of the area of all strata. In addition, reference points were also added to the catch rate figures. The solid line represents the 1990-2013 period average (long-term average) and the two dotted lines associated to the mean ±0.5 standard deviation corresponding respectively to the upper and lower reference limits. Note that for Capelin and Herring, the calculated indices are instead probability values (%) of encountering species during the survey. Indeed, due to the pelagic character of these two species, the bottom trawl is not an ideal fishing gear for their capture and, therefore, to accurately estimate abundance.

Note that the distinction between the two redfish species, *Sebastes fascietus and S. mentella*, is based on the analysis of the soft anal fin rays count and the depth of capture of individuals (H. Bourdages, DFO Mont-Joli, pers. comm.).

Length frequency distributions are presented in two different forms. The first figure shows the distribution for the last two years of the series plus the average distribution for the 1990-2014 period (long-term average distribution). Frequency values are expressed as the average number of individuals caught per tow in increment of 1 cm, except for Northern Shrimp (0.5 mm) and Atlantic Halibut (3 cm). The second figure represents the length distributions in length mean per class length for each year of the historical surveys series (1990 to 2015).

The geographical distribution of catches by weight per tow (kg/15 minutes tow, except for sea pens number/15 minutes tow) was made for periods of four years. The interpolation of CPUE was performed on a grid covering the study area using a ponderation inversely proportional to the distance (R version 2.13.0, Rgeos library; R Development Core Team 2011). The isoline contours were then plotted for four CPUE levels which approximate the 20th, 40th, 60th and 80th percentiles of the non-zero values. The catch rates distribution for the 2015 survey only is also presented in a bubbles type map.

The preliminary results for the abundance and biomass indices, the catch rate distribution maps, and the size frequency distributions for about 20 taxa commercially fished are presented at figures 4 to 60. These results are preliminary and must be considered as such until validations and laboratory analyses have been completed.

The average weight per tow for 56 taxa of fish and 97 taxa of invertebrates is given in figures 61 and 62. In these figures, a colour code is used to represent the difference between the CPUE in a given year and the average CPUE in the time series divided by the standard deviation of this average for each taxon.

The catches per tow for fish taxa are available on the St. Lawrence Global Observatory (SLGO). Finally, Appendix 2 provides a list of all taxa, vertebrates and invertebrates, caught among the 190 successful tows achieved during the 2015 survey. The occurrence, or the number of tows where the species was identified, as well as the total catch, by weight and numbers, are also presented. The number of specimens measured per taxon and some descriptive statistics for the length parameter are also presented in Appendix 3.

RESULTS

Warning: the bottom trawl survey is designed to sample deep-water demersal species, but catches can include pelagic species from the water column and small demersal species and invertebrates associated with coastal or rocky habitats, which are more difficult to trawl. Although these taxa are found in catches, they have a low catchability by trawl net. Some caution is required in interpreting the results obtained for these taxa.

BIODIVERSITY

In total, 84 fish taxa and 196 invertebrate taxa were identified during the mission.

Fish

American Plaice (*Hippoglossoides platessoides*) and **Witch Flounder** (*Glyptocephalus cynoglossus*) were caught very frequently, and their abundance was stable.

The abundance and biomass of **Atlantic Halibut** (*Hippoglossus hippoglossus*) remained high.

Atlantic Mackerel (*Scomber scombrus*) was observed in 24% of tows in 2015, compared to 3% of tows in previous years. These Mackerel were small, with modal lengths of 7 and 12 cm.

The abundance of **Black Dogfish** (*Centroscyllium fabricii*) has been above the historical average for four years, especially for juveniles 30–50 cm.

The average probability of catching **Capelin** (*Mallotus villosus*) in the survey decreased significantly in the past two years, especially in NAFO Division 4S.

The abundance and biomass indices for **Cod** (*Gadus morhua*) were comparable to 2014 levels and above the historical average. More and more Cod is being observed in 4S, especially around Anticosti Island.

The abundance and biomass of **Greenland Halibut** (*Reinhardtius hippoglossoides*) were comparable to 2014 and above the historical average. Reduced growth of juveniles was observed. The cohort of two-year-old fish had a modal length of 22 cm, whereas the historical average is 26 cm.

In 2015, **Haddock** (*Melanogrammus aeglefinus*) was observed in the estuary and western Gulf for the first time since this survey began in 1990. This Gadid is very rarely caught in the northern Gulf.

The average probability of catching **Herring** (*Clupea harengus*) in 4R increased over the past two years but decreased in 4S for the same period.

The abundance of **Longfin Hake** (*Phycis chesteri*) remained low, and distribution was restricted to a portion of the Laurentian Channel. None have been caught in the estuary for several years.

In recent years, an increase in the abundance of **Redfish** has been observed. There have been three strong cohorts of Deepwater Redfish (*Sebastes mentella*), with the most abundant being

the 2011 cohort, which now has a modal length of 17 cm. These young Redfish were distributed throughout the northern Gulf.

Since 2007, **Silver Hake** (*Merluccius bilinearis*) has been present in the northern Gulf more frequently.

Thorny Skate (*Amblyraja radiata*) and **Smooth Skate** (*Malacoraja senta*) were caught very frequently, and their abundance was stable.

The abundance of **White Hake** (*Urophycis tenuis*) is increasing. For the first time since 2001, it was above the historical average.

Invertebrates

The abundance and biomass of **Northern Shrimp** (*Pandalus borealis*) have been average and stable for five years.

Recently, there has been a decrease in the abundance of **Northern Shortfin Squid** (*Illex illecebrosus*), a southern, seasonal pelagic species.

For the second consecutive year, abundant catches of **Moon Jellyfish** (*Aurelia aurita*) were observed off the coast of Newfoundland. It was rarely observed in this survey before 2014.

There are four species of sea pens in the Northern Gulf of St Lawrence. The larger sea pens (*Anthoptilum grandiflorum, Halipteris finmarchica, Pennatula grandis*) are distributed in deep areas of the Laurentian Channel, and the smaller sea pen (*Pennatula aculeata*) is more widely distributed.

PHYSICAL OCEANOGRAPHIC CONDITIONS

A preliminary analysis of water temperature data collected in 2015 showed very warm (record) conditions in deep water (150 m and deeper), but temperatures near normal in the cold intermediate water layer and summer surface waters.

Air temperatures above the Gulf were well below normal in winter and below normal in spring. August was the only month when they were above normal; this month was the second hottest since 1873, after 2012. This combination led to near-normal average surface water temperatures for May–August and July–August (compared to 1985–2010 climatology).

After the cold winter, temperatures in the summer cold intermediate water layer were near normal climatological levels (Figure 63). However, the layers were thinner than normal, especially in the northwestern Gulf.

Beneath the cold intermediate water layer, the estuarial flow that carries deep water to the channel heads spread the warm water that had been in the Cabot Strait, central Gulf and Esquiman Channel for a few years upstream. Consequently, temperatures at 200 and 300 m increased in most areas from 2014, especially in the Anticosti Channel at 200 m and the estuary, northwestern Gulf and central Gulf at 300 m (Figure 63). Taking into consideration all the data recorded in different months of the year, the northwestern Gulf, Anticosti Channel, central Gulf and Esquiman Channel are currently experiencing record temperatures since 1915 at 200 m (temperatures of 5.2 °C, 5.6 °C, 5.9 °C and 5.9 °C respectively). At 300 m, the estuary, northwestern Gulf, Anticosti Channel and Esquiman Channel are experiencing record temperatures (5.4 °C, 5.8 °C, 6.4 °C, 6.3 °C). The Gulf-wide average temperature reached a record level since 1915 at all depths from 150 m to 300 m. Note that the southwestern portion of the Mécatina Basin did not have the cold deep water layer typical of the area, but warmer water more closely resembling the Esquiman Channel.

Figure 64 summarizes these findings and gives the temperature records at 200 m and 300 m. However, the temperature of the cold intermediate water layer and the average summer surface temperatures up to August were near normal.

ACKNOWLEDGEMENTS

We would like to thank both crews of the *CCGS Teleost* and wish to highlight the excellent work of the 2015 scientific team. The science team consisted of Luc Beaudin, Denis Bernier, Hugo Bourdages, Claude Brassard, Jean-Yves Couture, Sylvain Chartrand, Pierre-Marc Chouinard, Valérie de Carufel, Rémi Desmarais, Daniel Duplisea, Johanne Gauthier, Claudie Lacroix-Lepage, Isabelle Lévesque, Jean-François Lussier, Marie-Claude Marquis, Chantale Mathot, Samuel Mongrain, Claude Nozères, Éric Parent, Bernard Pettigrew, Philippe Schwab, Evelyne Sigouin, Sylvie St-Pierre, Alexandra Valentin and Fanny Vermandele.

Finally, we would like to thank Denis Bernier and Claude Savenkoff for reviewing this document.

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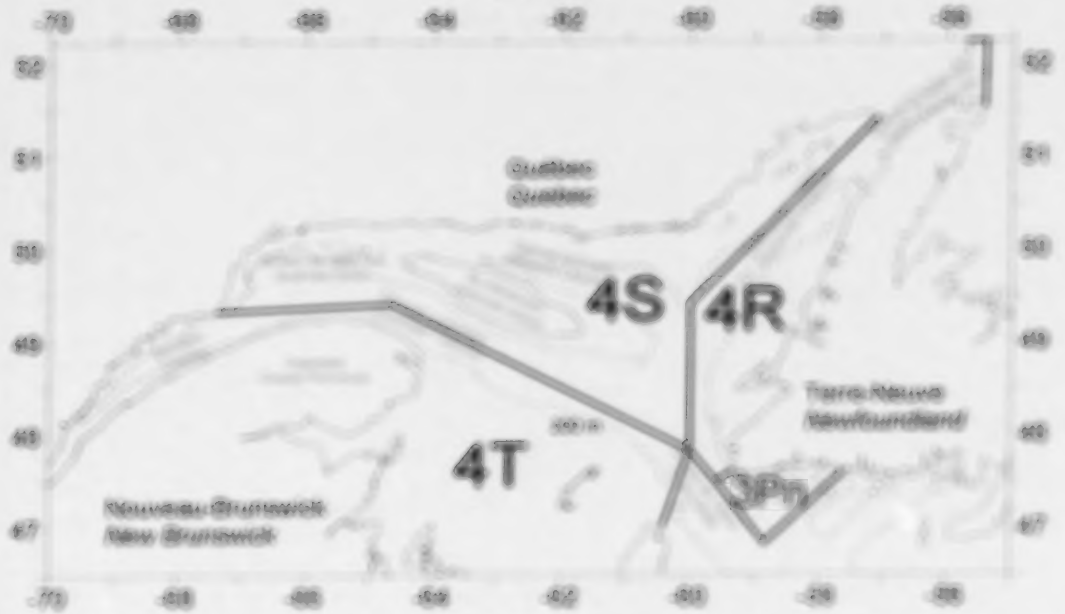


Figure 1. NAFO Divisions of the Estuary and Gulf of St. Lawrence and names of locations mentioned in the text.

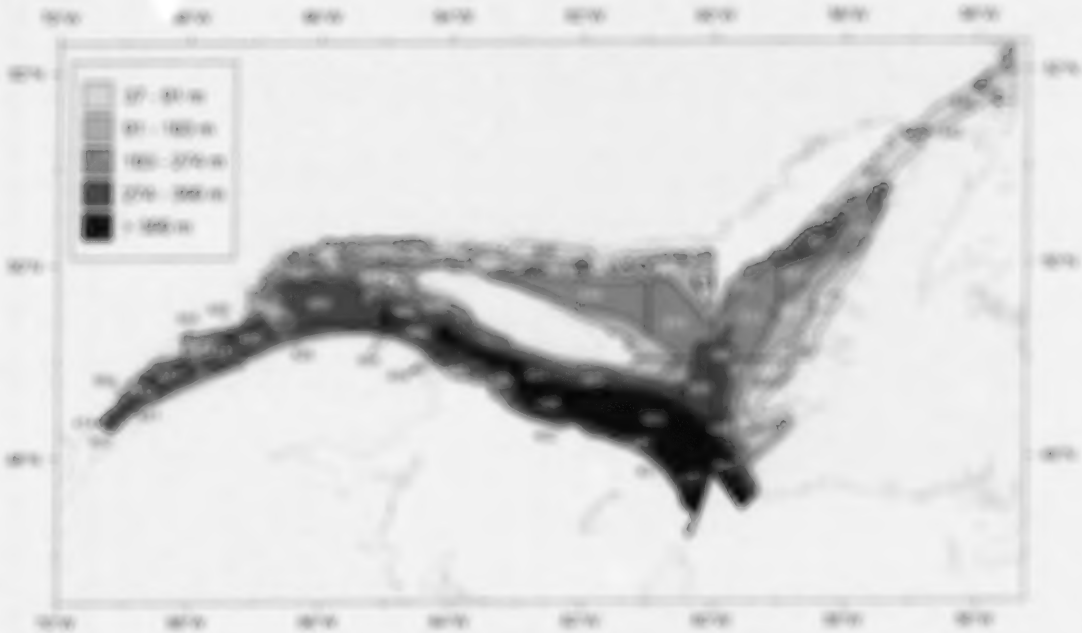


Figure 2. Stratification scheme used for the groundfish and shrimp research survey in the Estuary and northern Gulf of St. Lawrence.

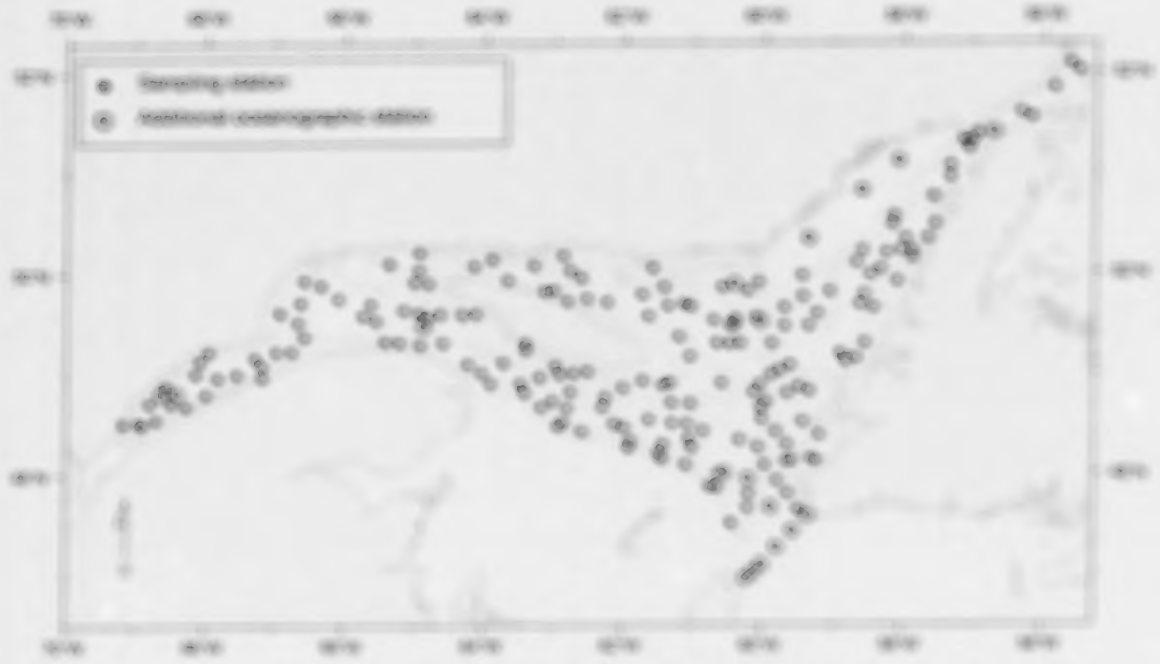


Figure 3: Locations of successful sampling stations (trawl and oceanography) and additional oceanographic stations for the 2018 survey.

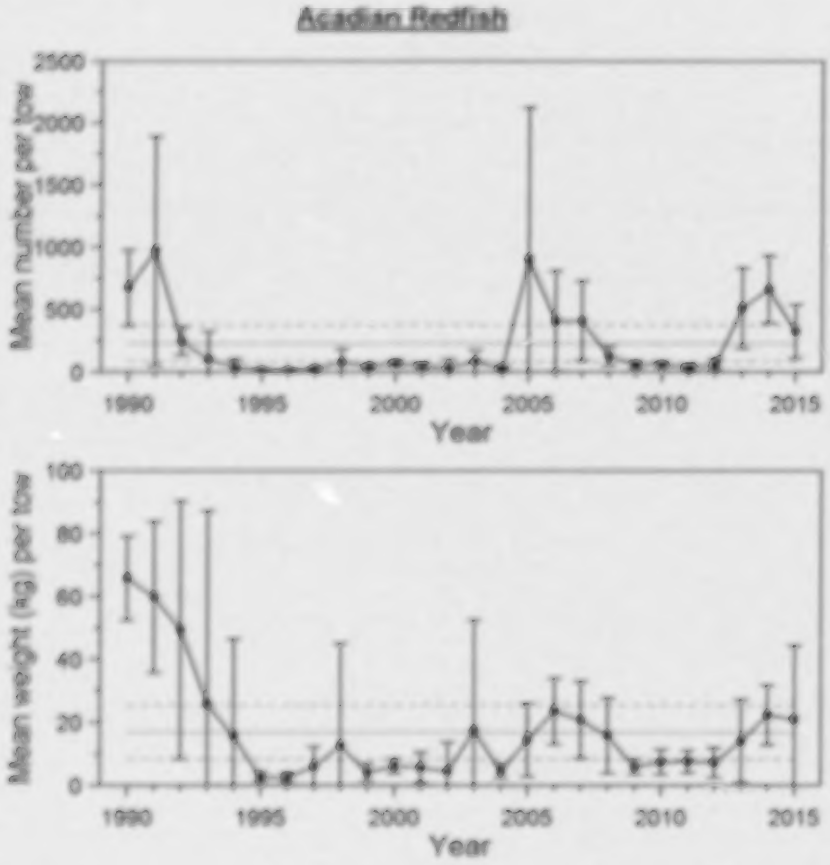


Figure 4. Mean numbers and mean weights per 15 minutes tow observed during the survey for Acadian Redfish in 4RST. Error bars indicate the 95% confidence interval and the horizontal lines indicate the mean of the 1990-2014 period (solid line) and upper and lower reference (see text) limits (dashed lines).

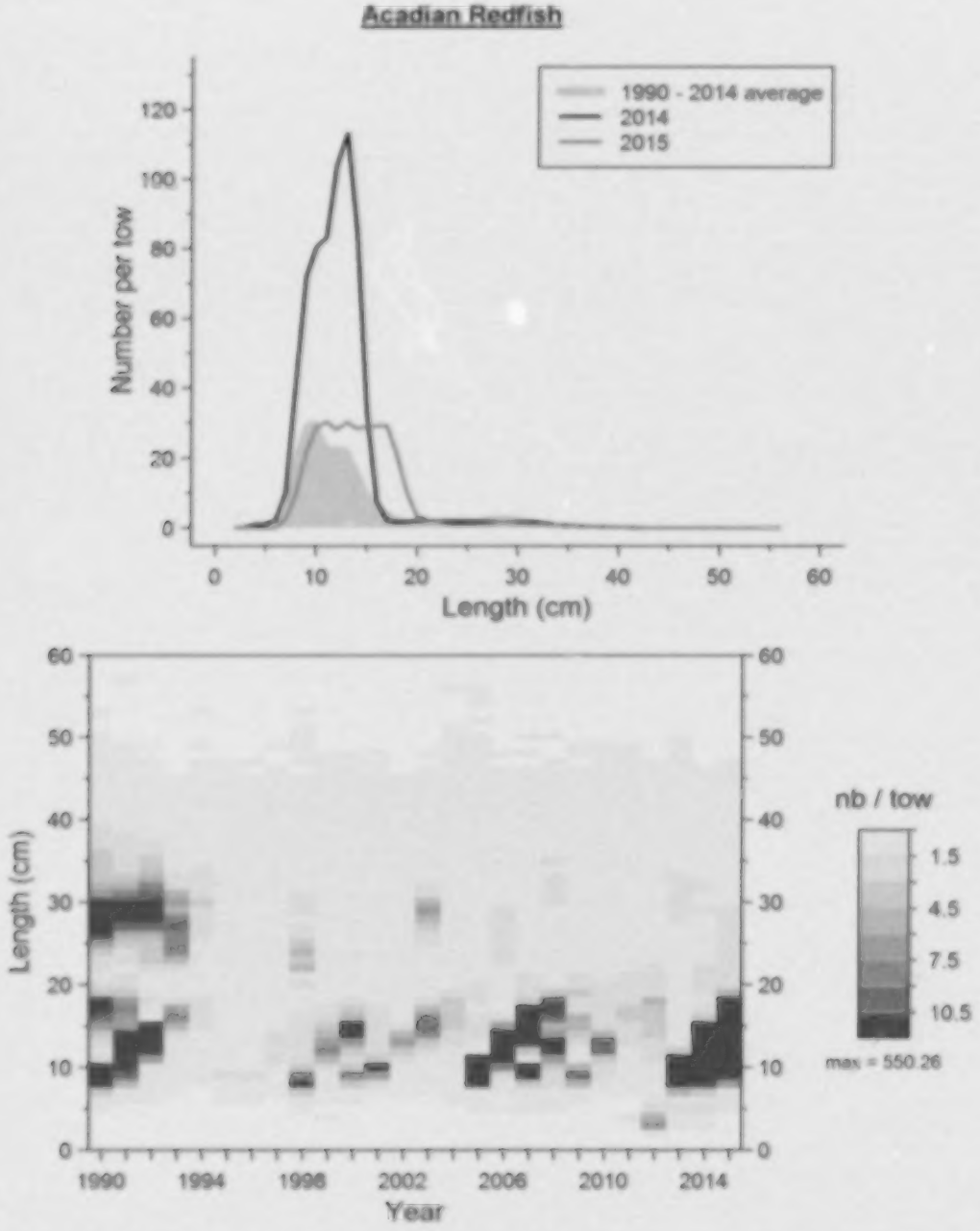


Figure 5. Length frequency distributions (mean number per 15 minutes tow) observed during the survey for Acadian Redfish in 4RST.

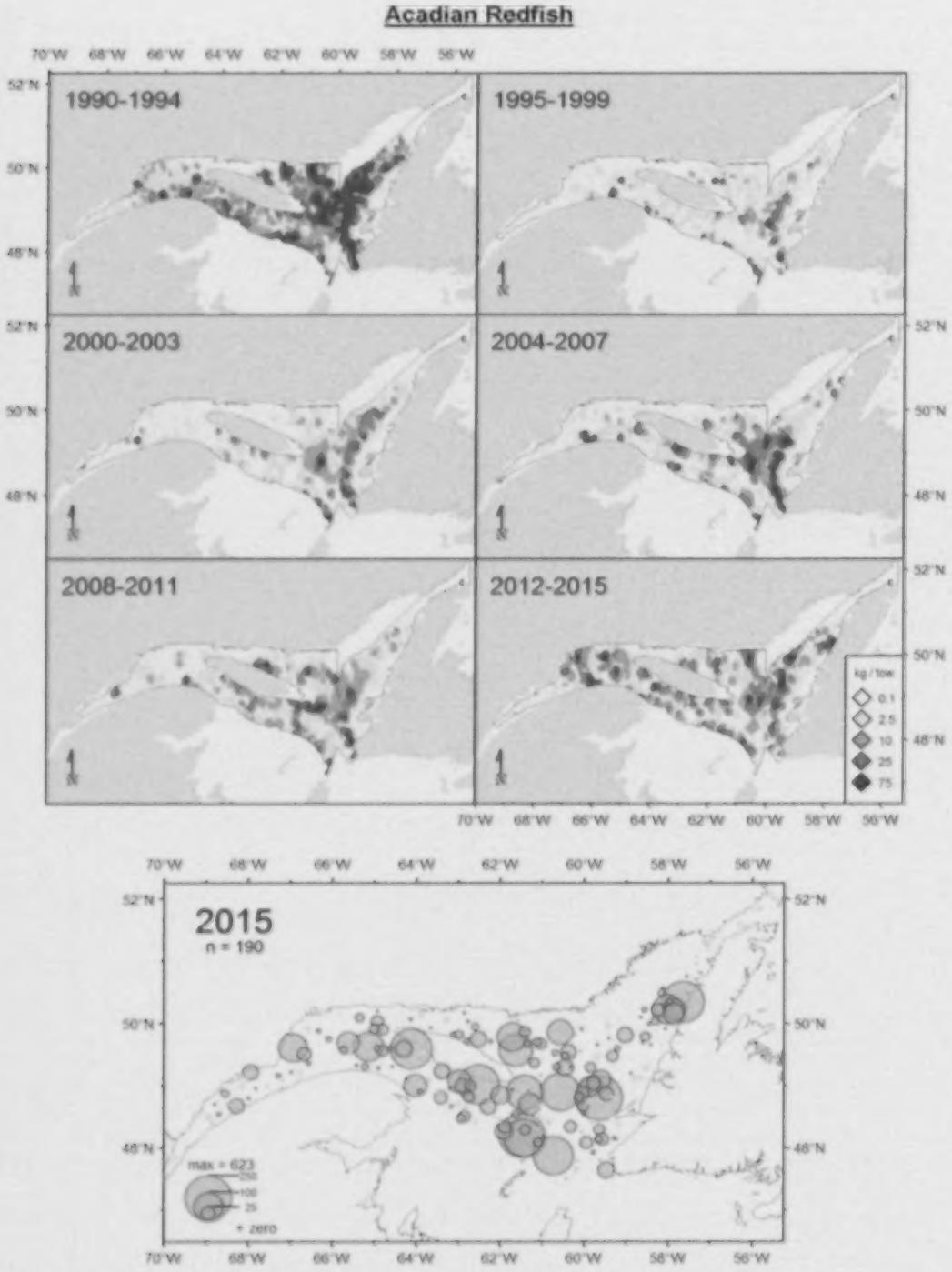


Figure 6. Acadian Redfish catch rates (kg/15 minutes tow) distribution.

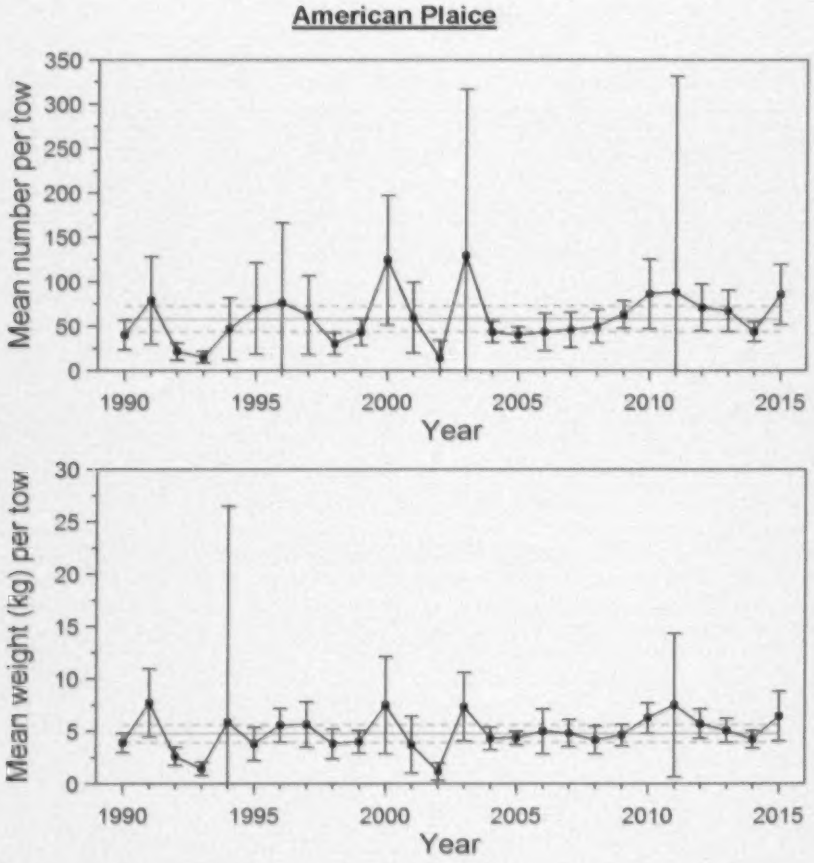


Figure 7. Mean numbers and mean weights per 15 minutes tow observed during the survey for American Plaice in 4RST. Error bars indicate the 95% confidence interval and the horizontal lines indicate the mean of the 1990-2014 period (solid line) and upper and lower reference (see text) limits (dashed lines).

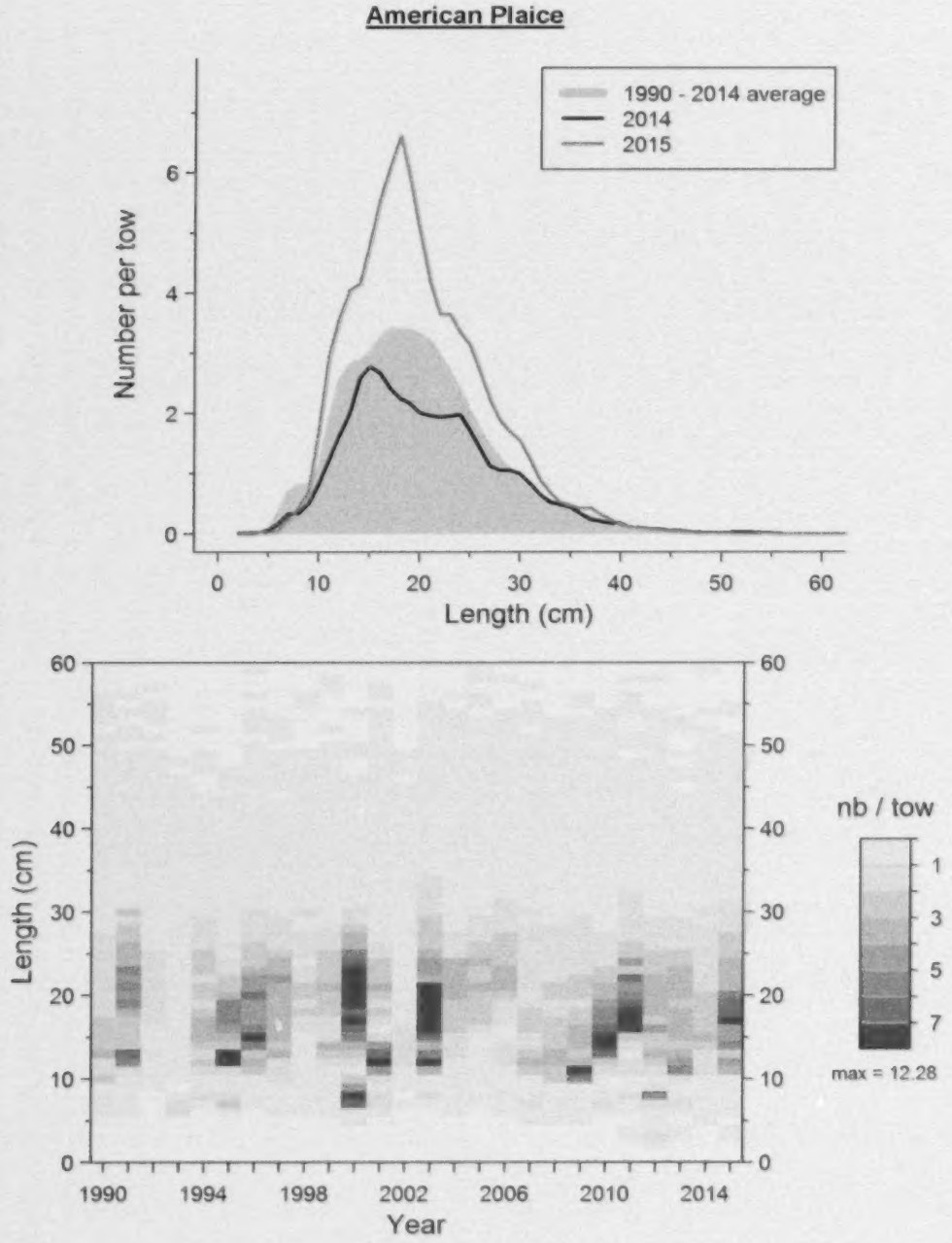


Figure 8. Length frequency distributions (mean number per 15 minutes tow) observed during the survey for American Plaice in 4RST.

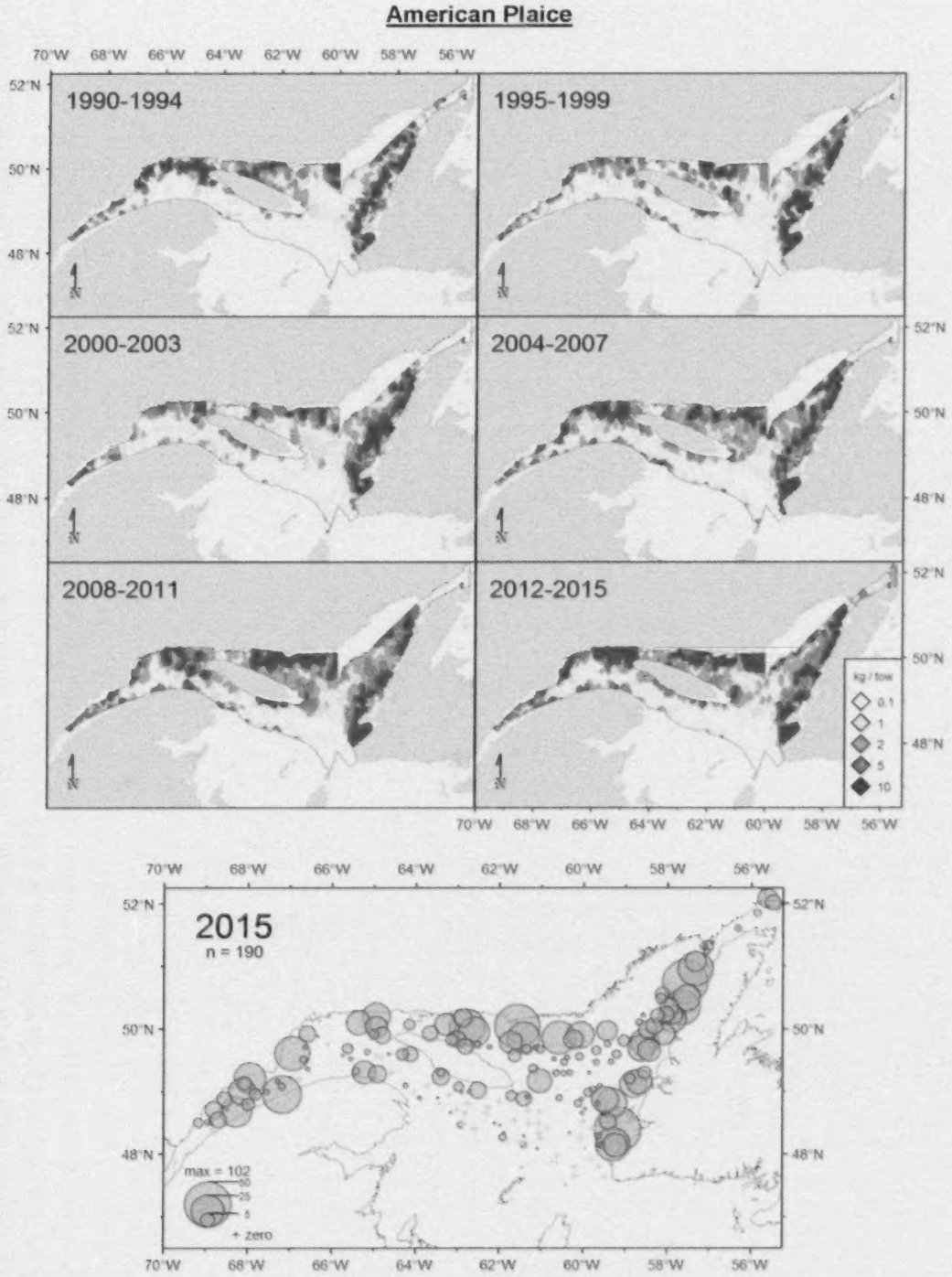


Figure 9. American Plaice catch rates (kg/15 minutes tow) distribution.

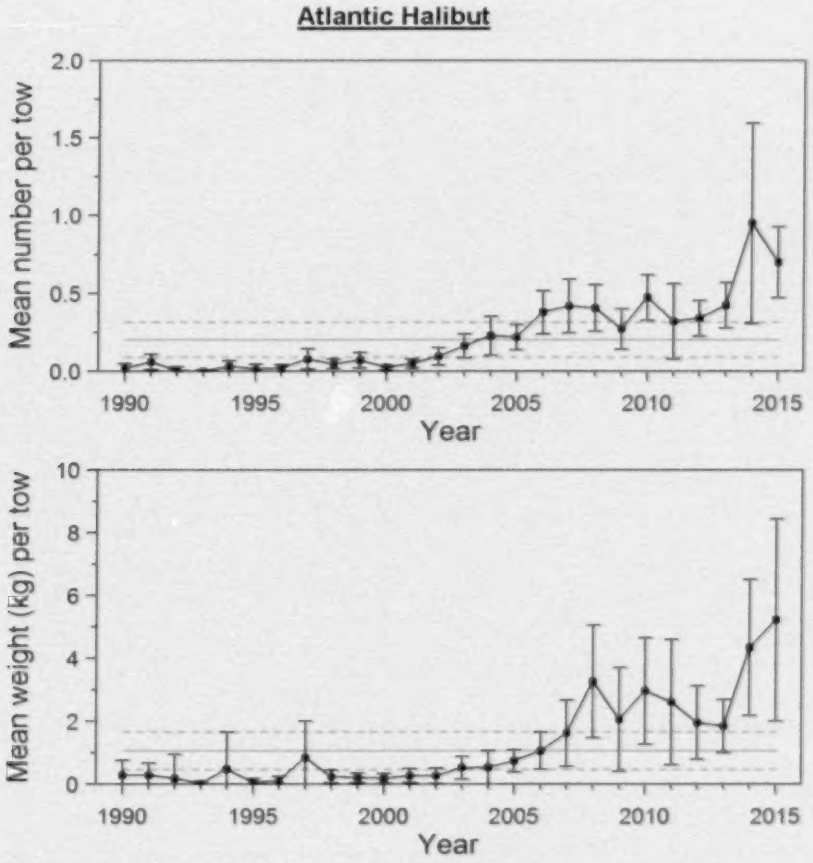


Figure 10. Mean numbers and mean weights per 15 minutes tow observed during the survey for Atlantic Halibut in 4RST. Error bars indicate the 95% confidence interval and the horizontal lines indicate the mean of the 1990-2014 period (solid line) and upper and lower reference (see text) limits (dashed lines).

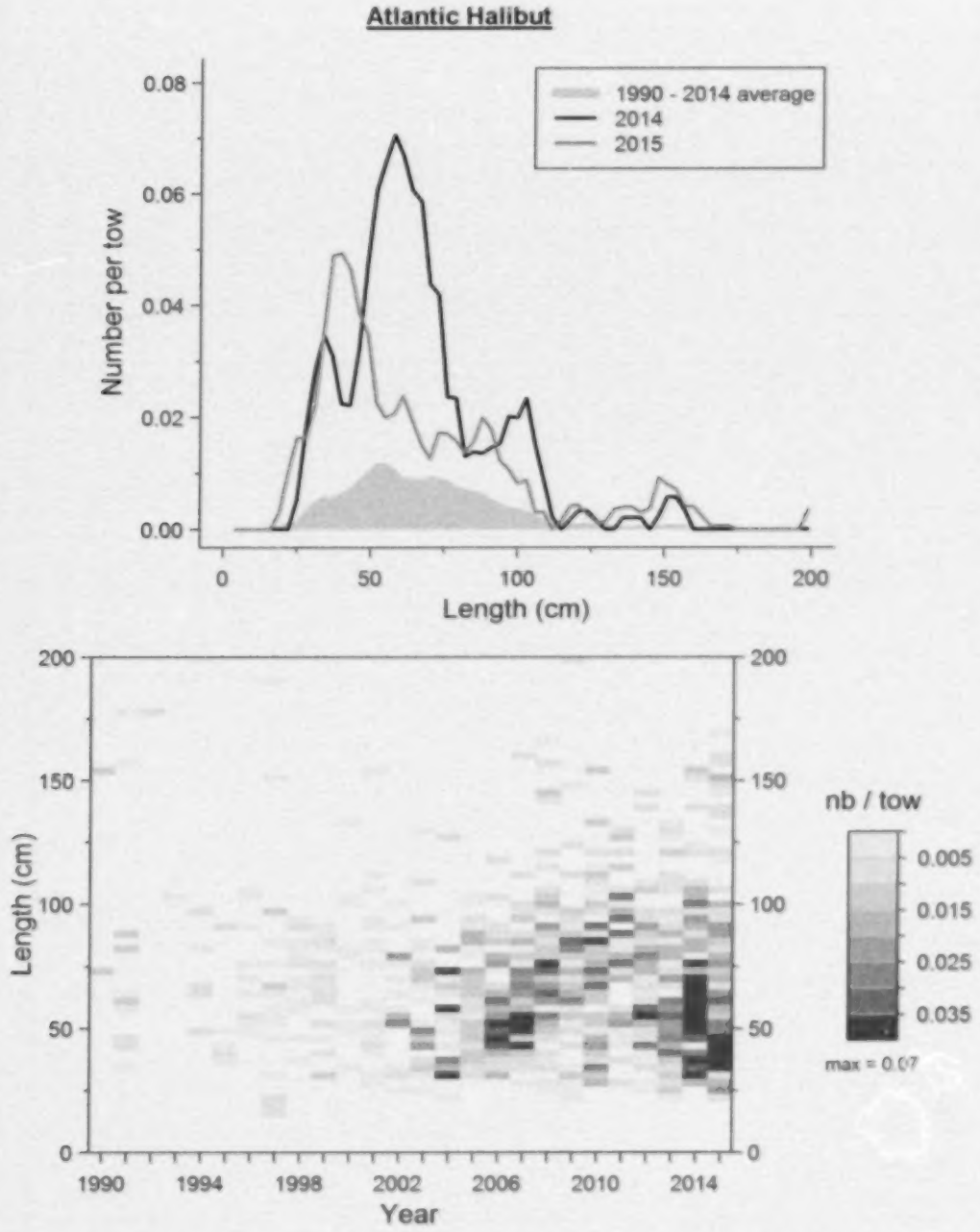


Figure 11. Length frequency distributions (mean number per 15 minutes tow) observed during the survey for Atlantic Halibut in 4RST.

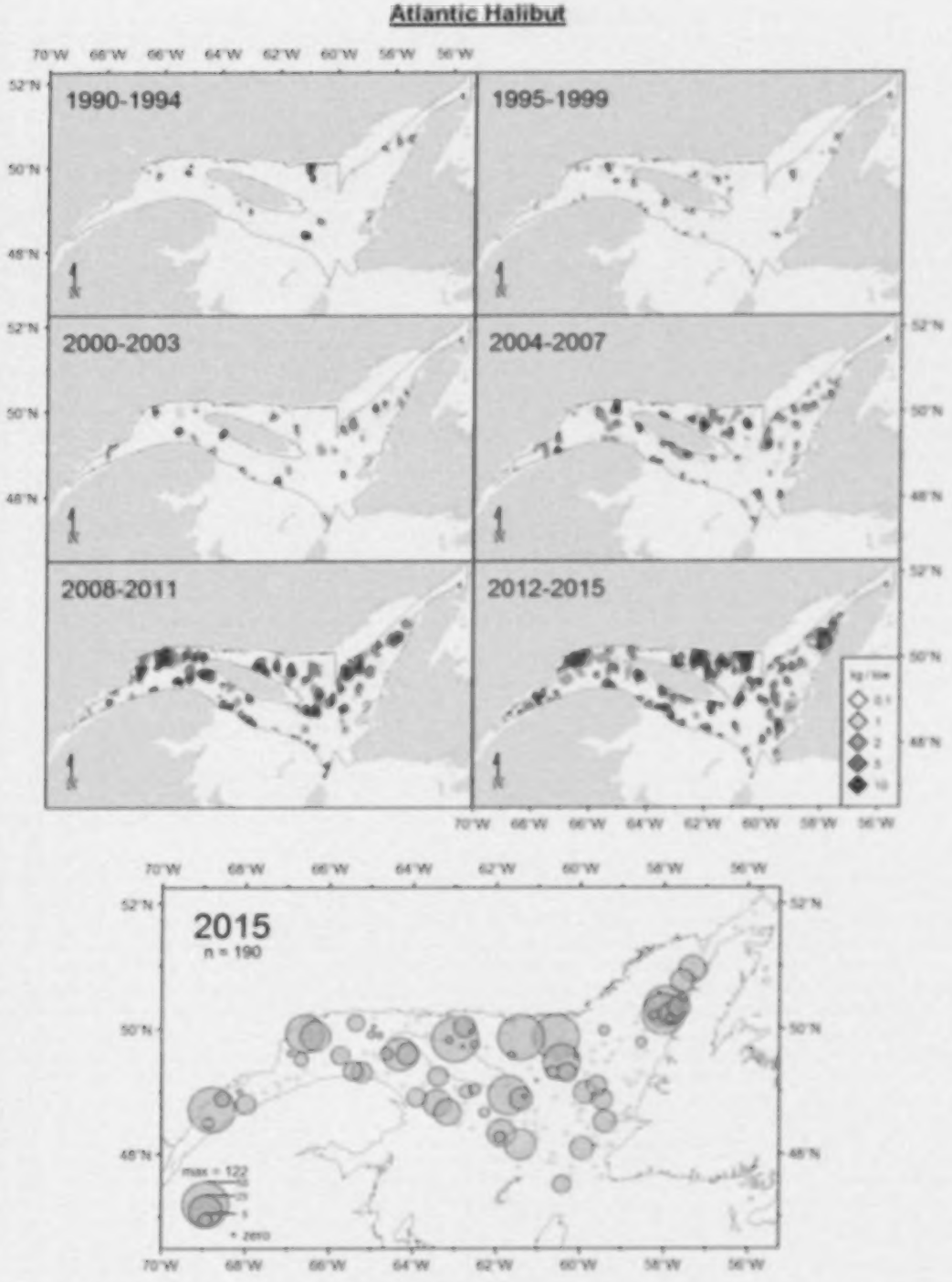


Figure 12. Atlantic Halibut catch rates (kg/15 minutes tow) distribution.

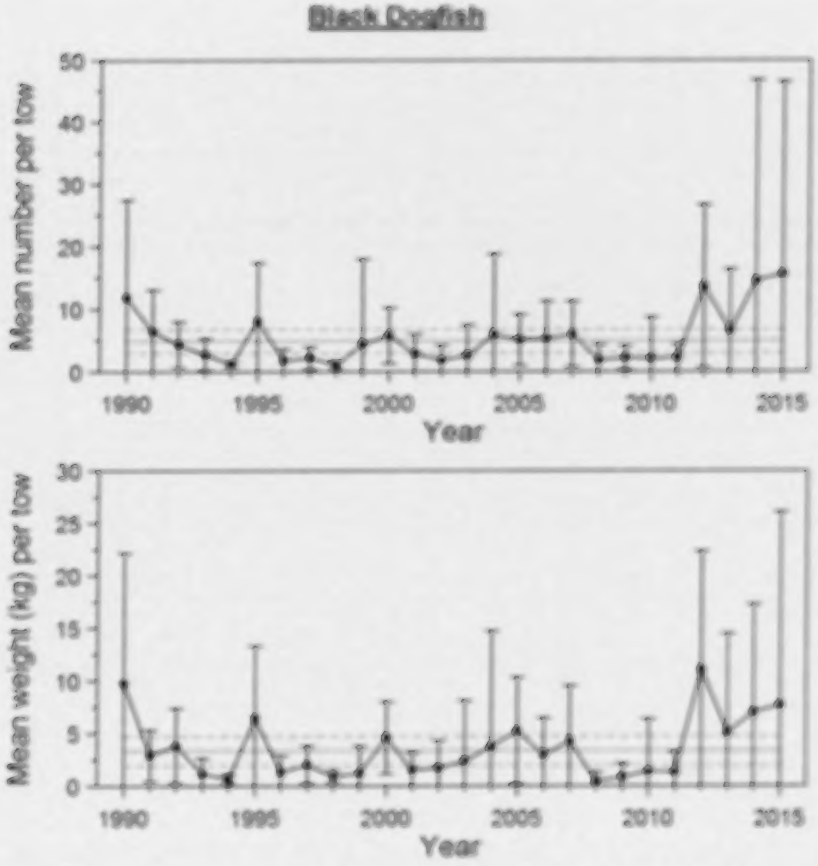


Figure 13. Mean numbers and mean weights per 15 minutes tow observed during the survey for Black Dogfish in 4RST. Error bars indicate the 95% confidence interval and the horizontal lines indicate the mean of the 1990-2014 period (solid line) and upper and lower reference (see text) limits (dashed lines).

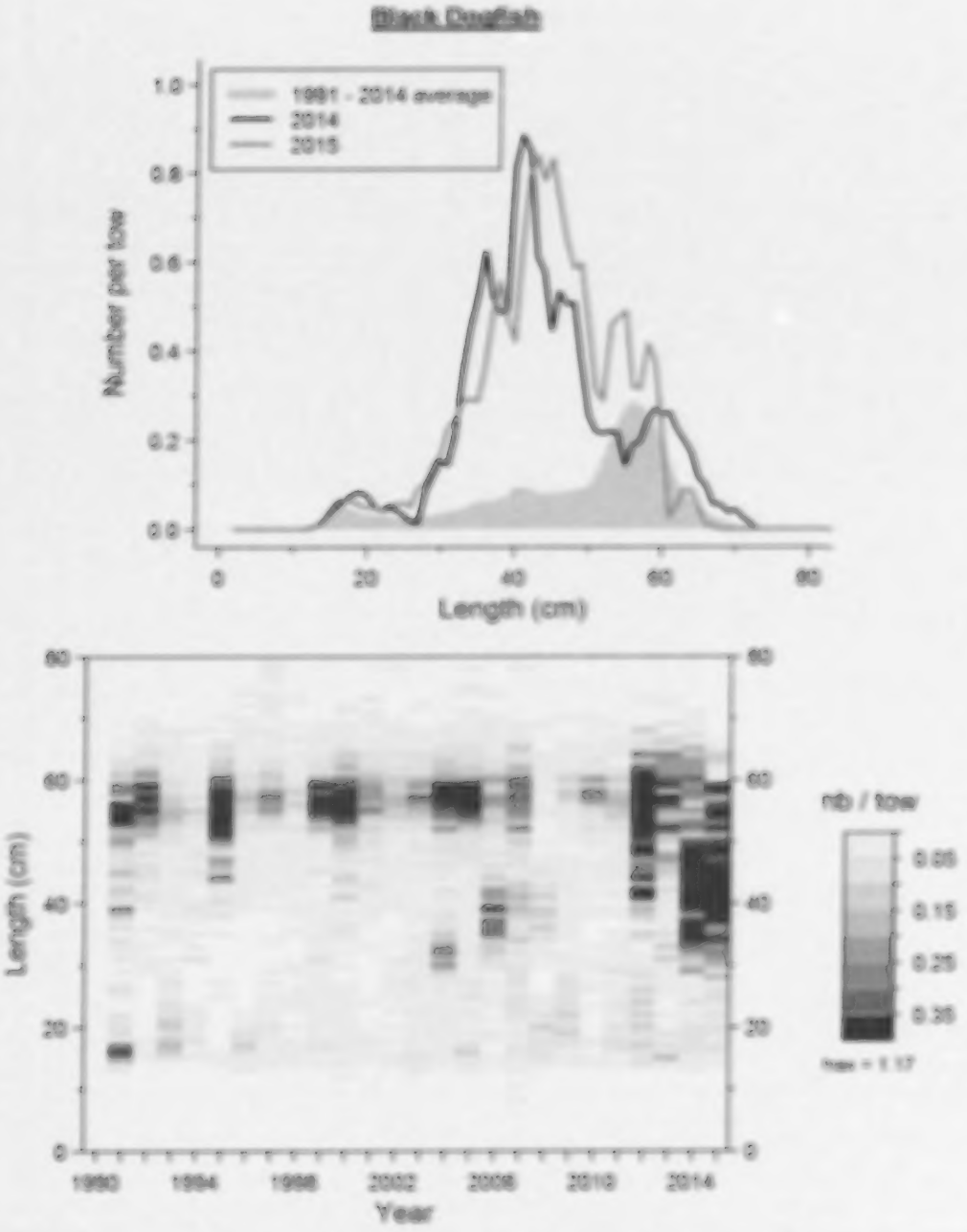


Figure 14. Length frequency distributions (mean number per 15 minutes tow) observed during the survey for Black Dogfish in 4RST.

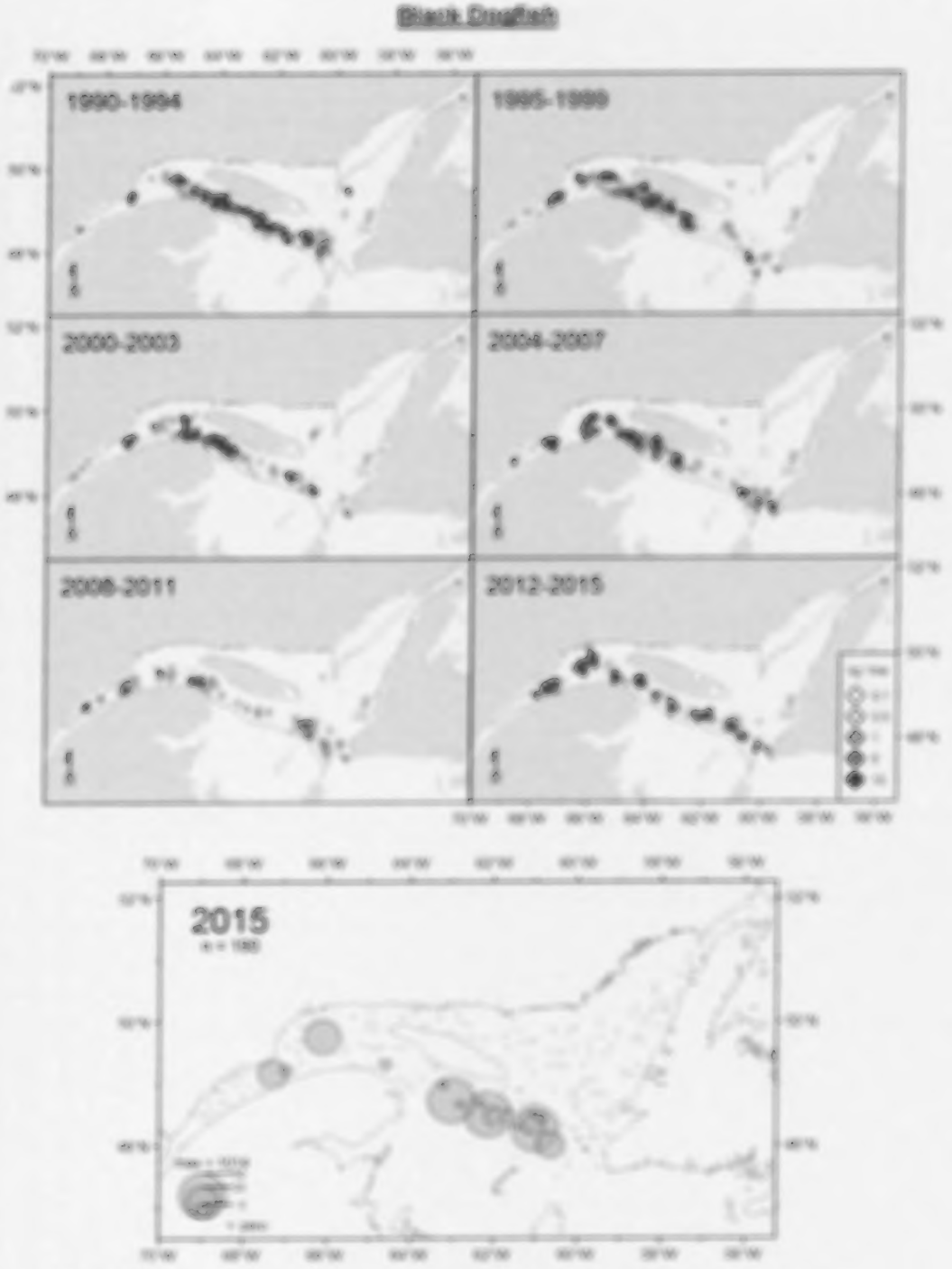


Figure 19. Black Dogfish catch rates (kg/15 minutes tow) distribution.

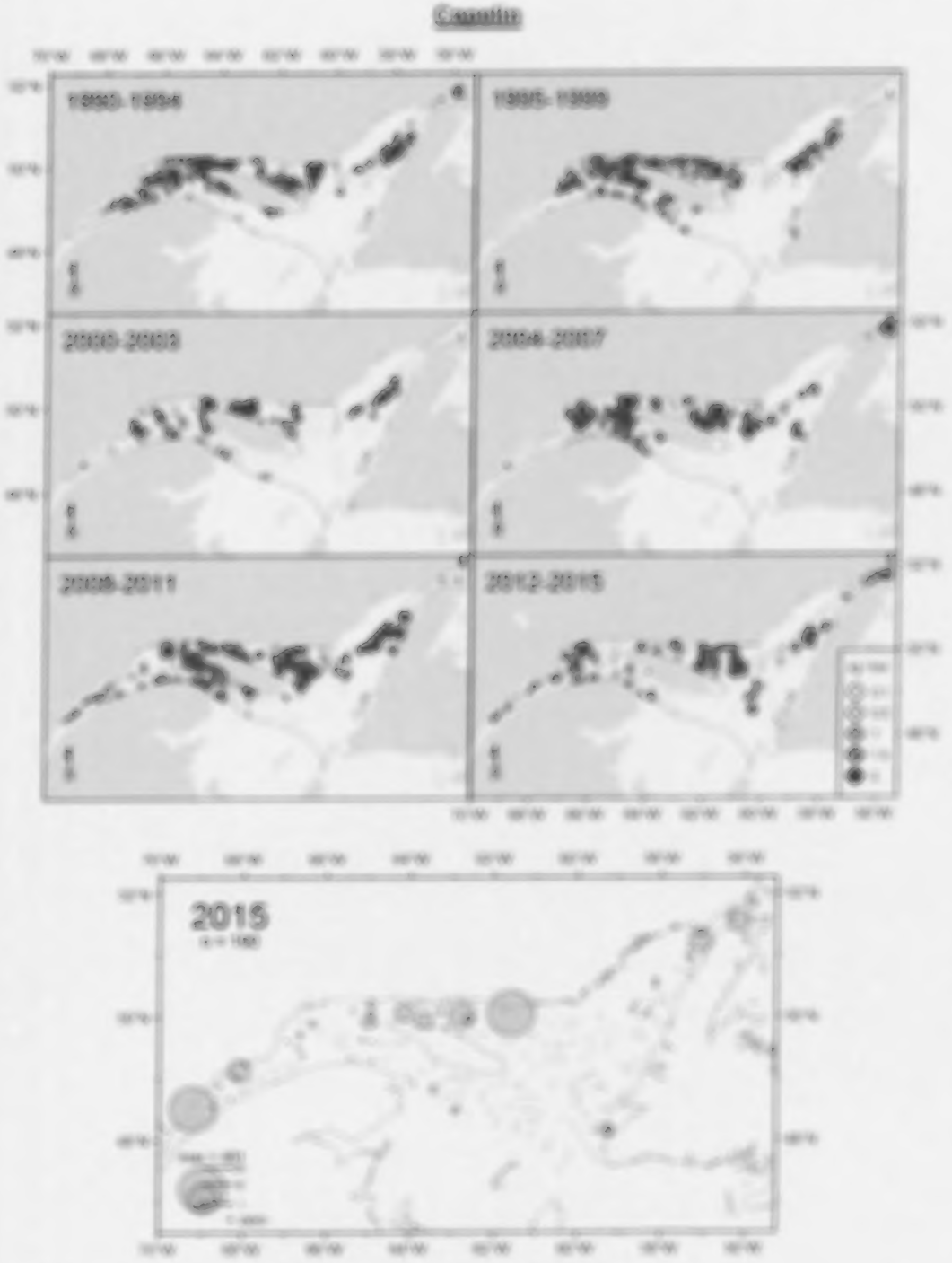


Figure 19. Capelin catch rates (kg/15 minutes tow) distribution.

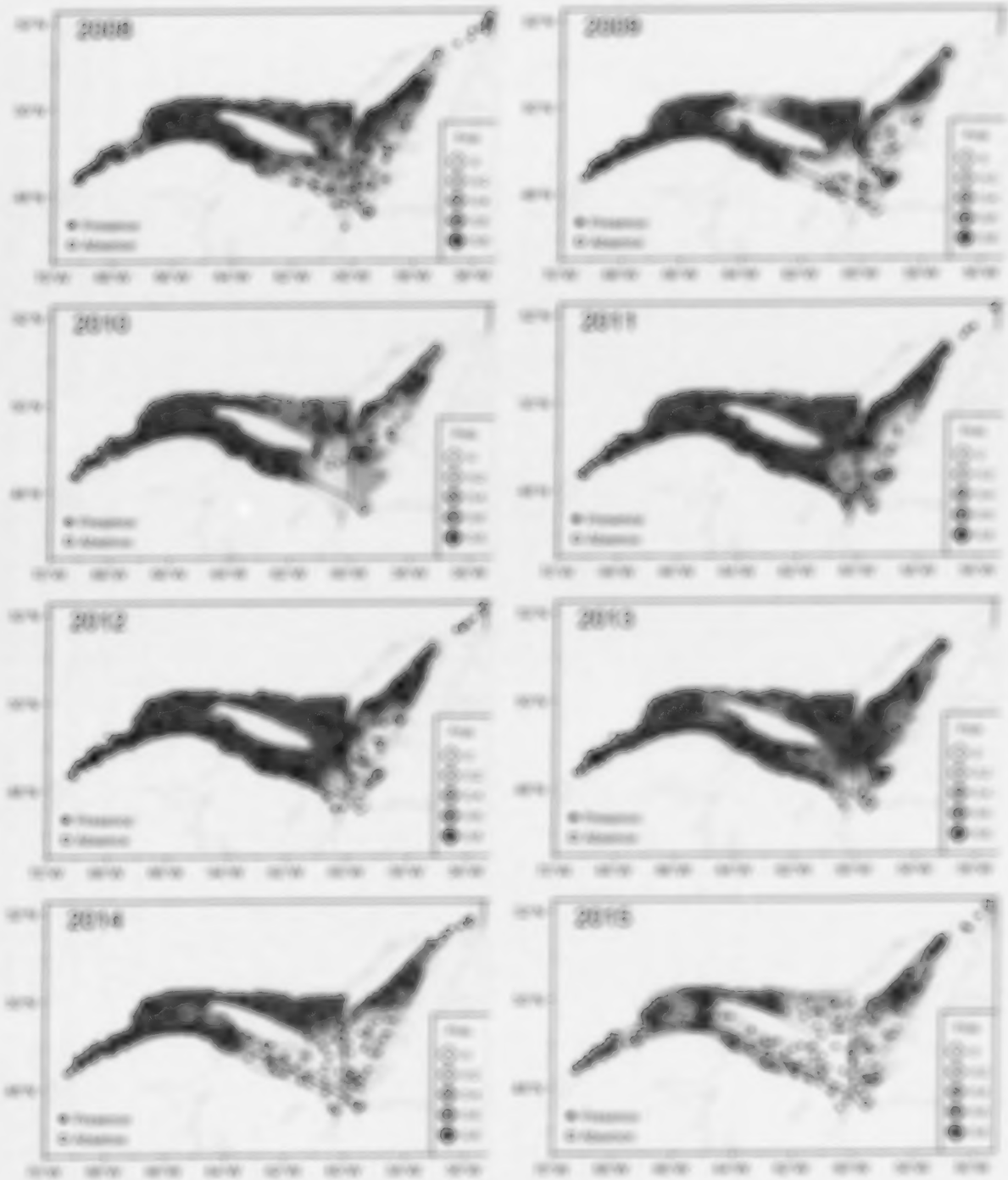
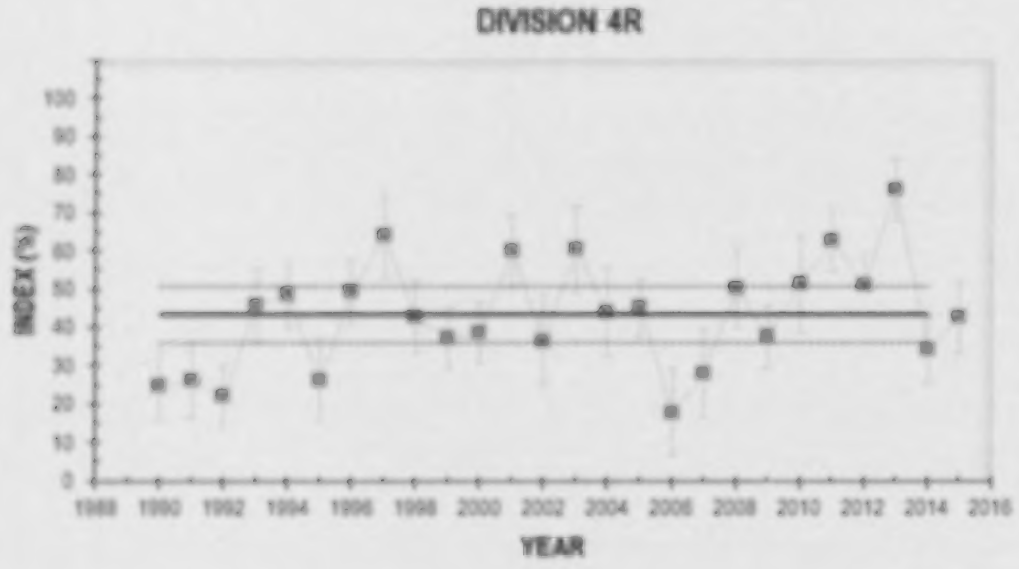


Figure 17. Probabilities areas (%) associated with the presence of Capelin

Capelin



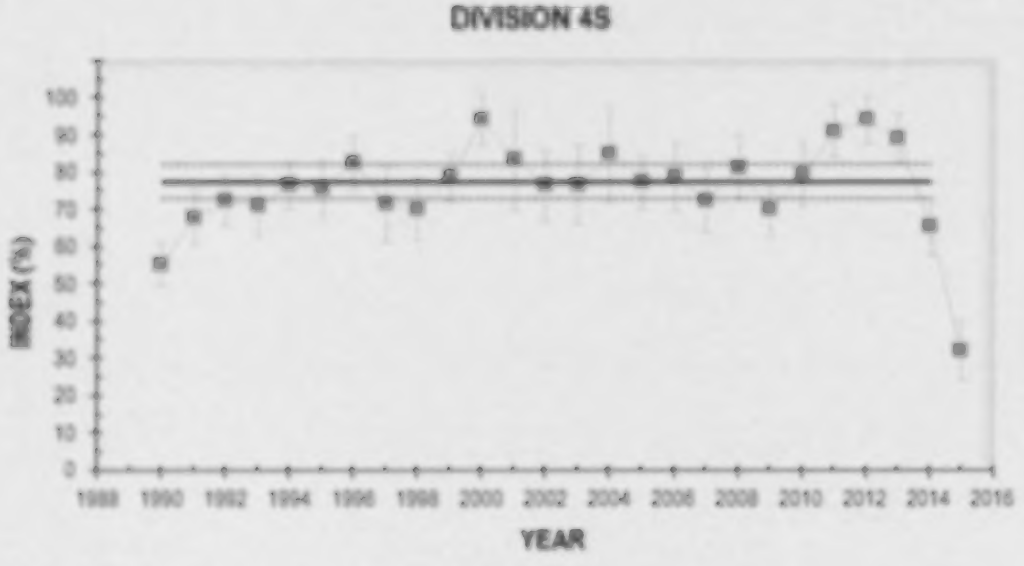


Figure 18. Mean probabilities of finding Capelin in NAFO Divisions 4R and 4S. Error bars indicate the 95% confidence interval and the horizontal lines indicate the mean of the 1990-2014 period (solid line) and upper and lower reference (see text) limits (dashed lines).

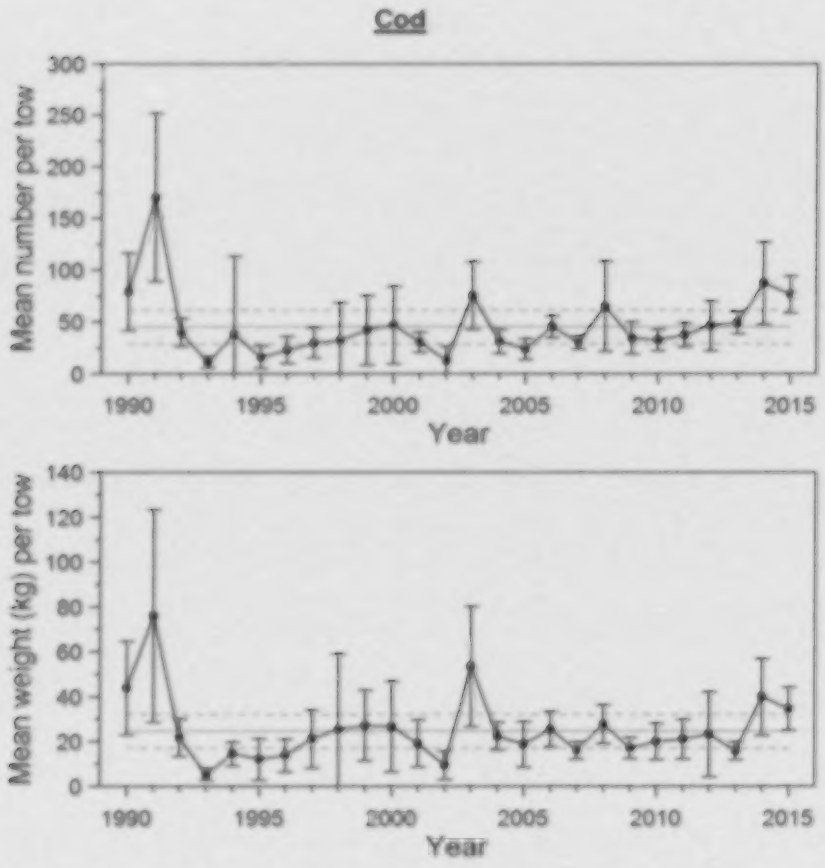


Figure 19. Mean numbers and mean weights per 15 minutes tow observed during the survey for Cod in 4RS. Error bars indicate the 95% confidence interval and the horizontal lines indicate the mean of the 1990-2014 period (solid line) and upper and lower reference (see text) limits (dashed lines).

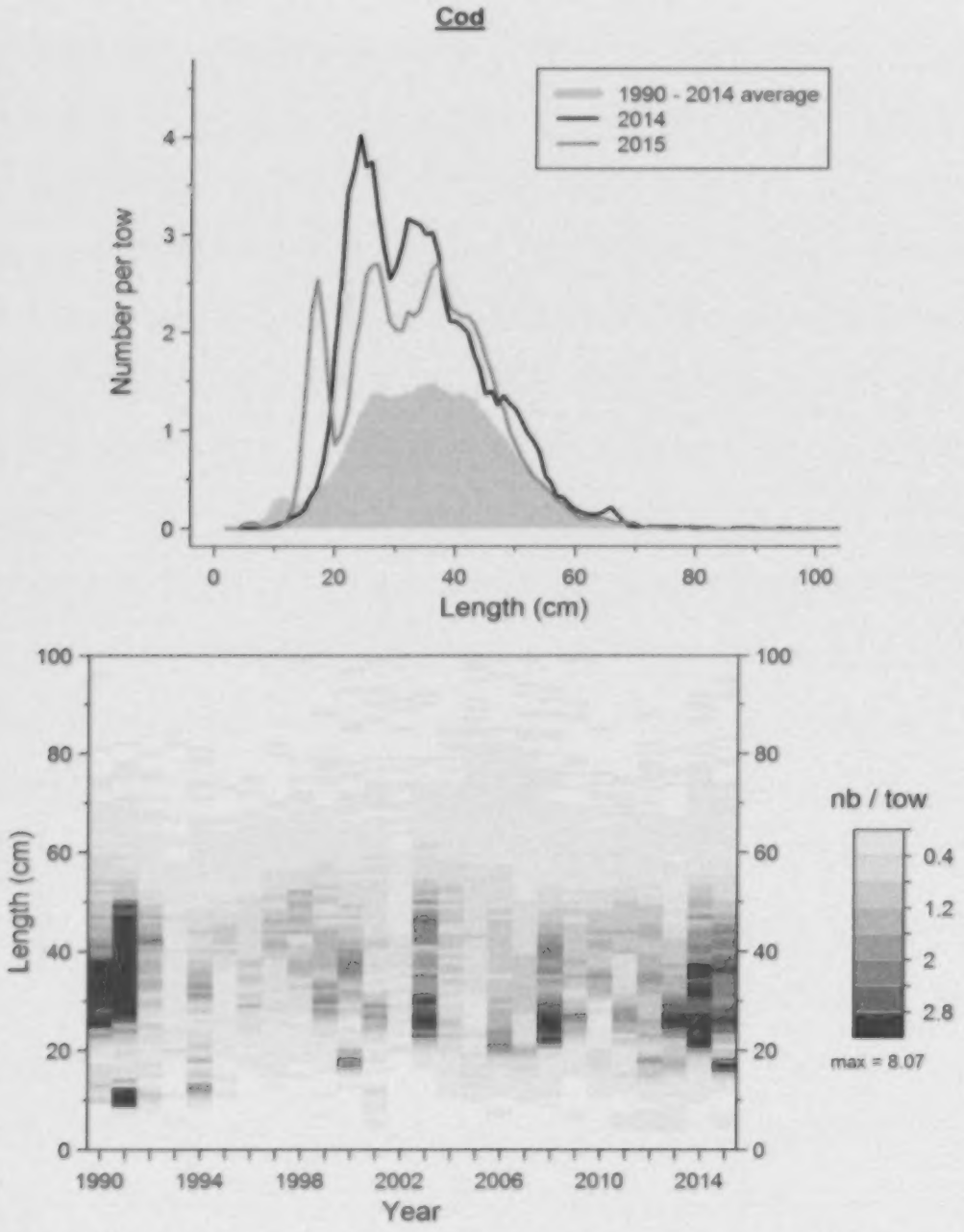


Figure 20. Length frequency distributions (mean number per 15 minutes tow) observed during the survey for Cod in 4RS.

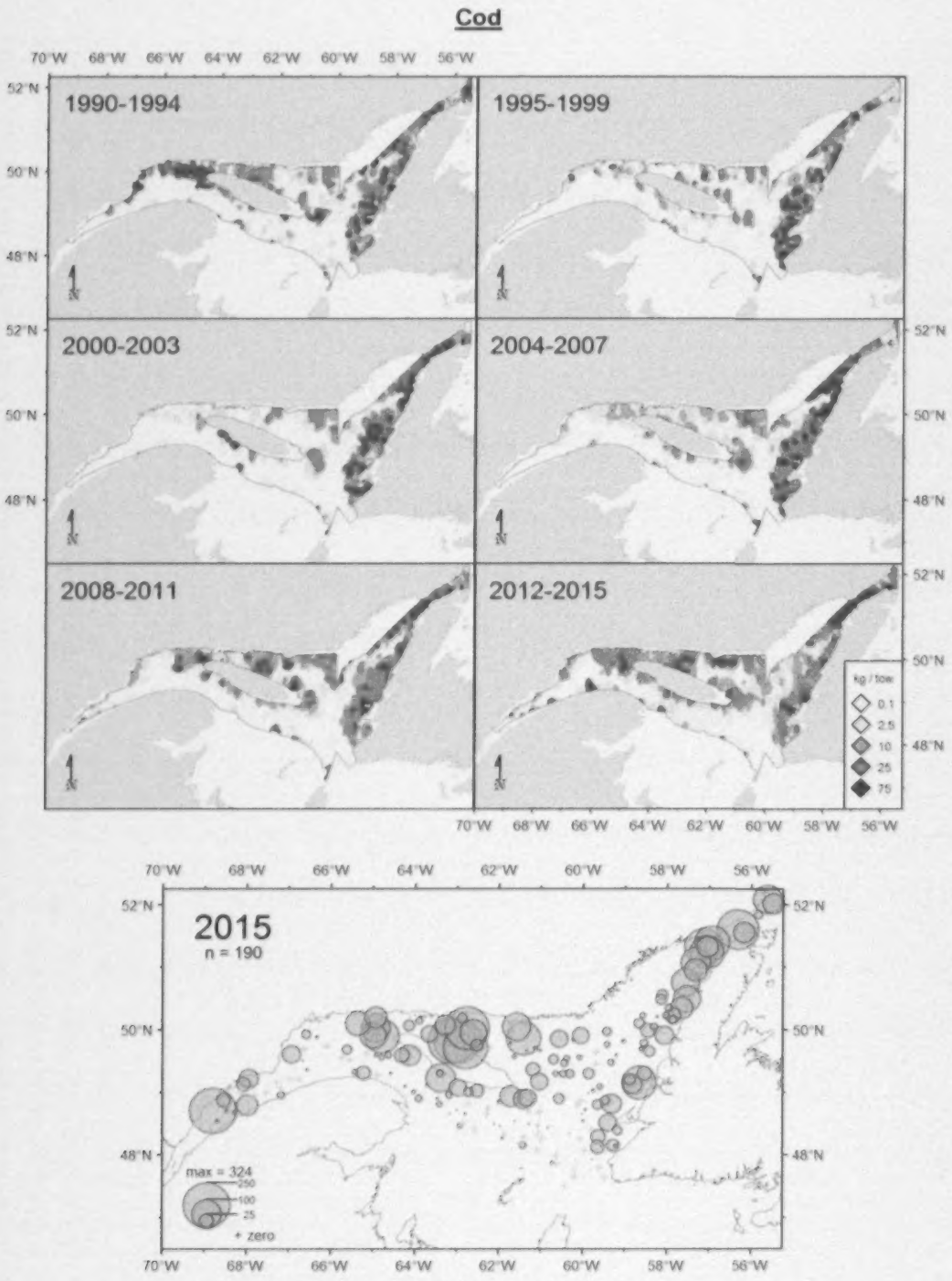


Figure 21. Cod catch rates (kg/15 minutes tow) distribution.

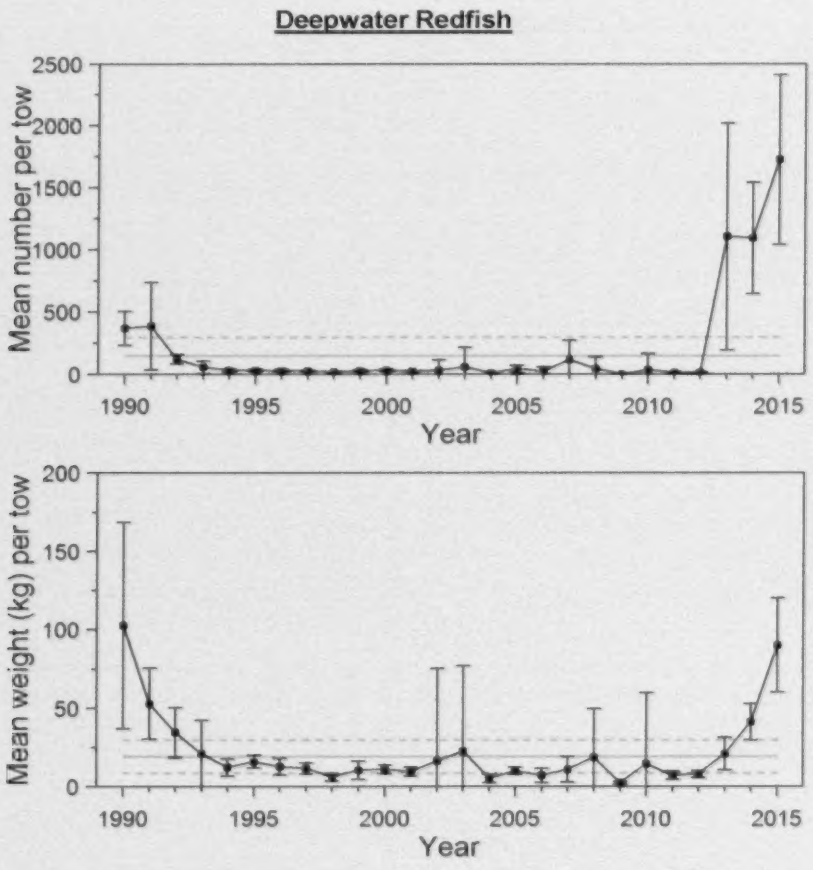


Figure 22. Mean numbers and mean weights per 15 minutes tow observed during the survey for Deepwater Redfish in 4RST. Error bars indicate the 95% confidence interval and the horizontal lines indicate the mean of the 1990-2014 period (solid line) and upper and lower reference (see text) limits (dashed lines).

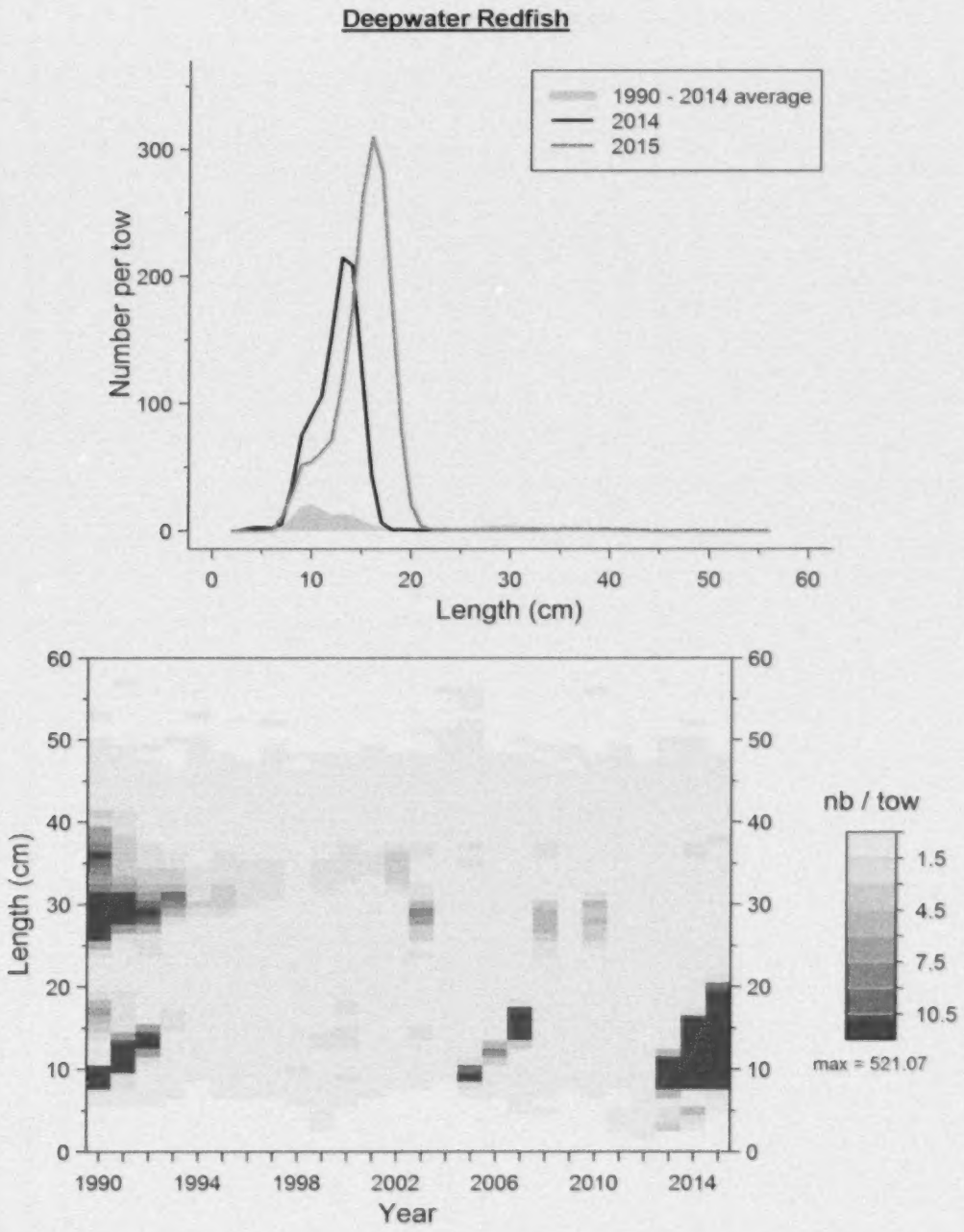


Figure 23. Length frequency distributions (mean number per 15 minutes tow) observed during the survey for Deepwater Redfish in 4RST.

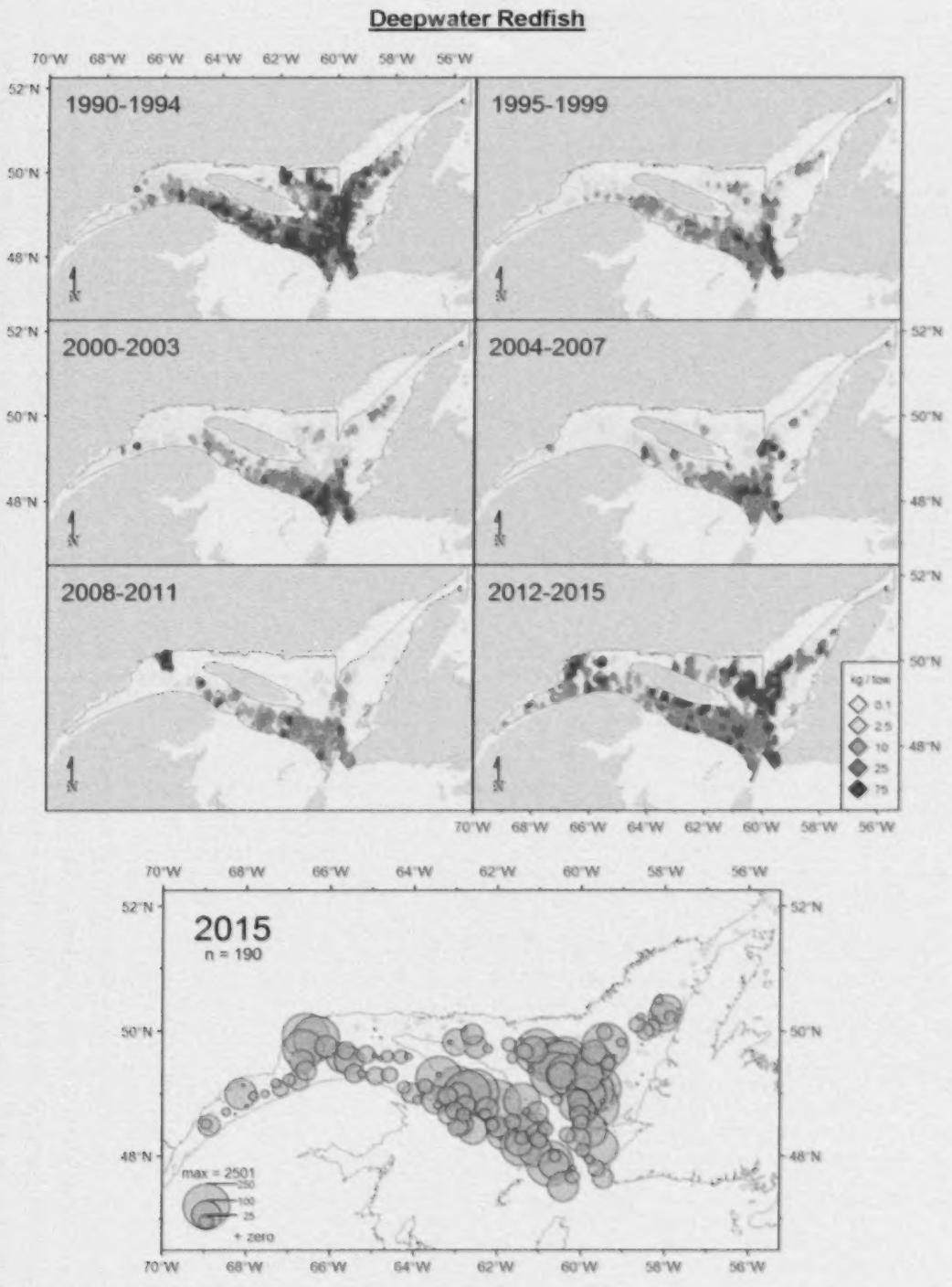


Figure 24. Deepwater Redfish catch rates (kg/15 minutes tow) distribution.

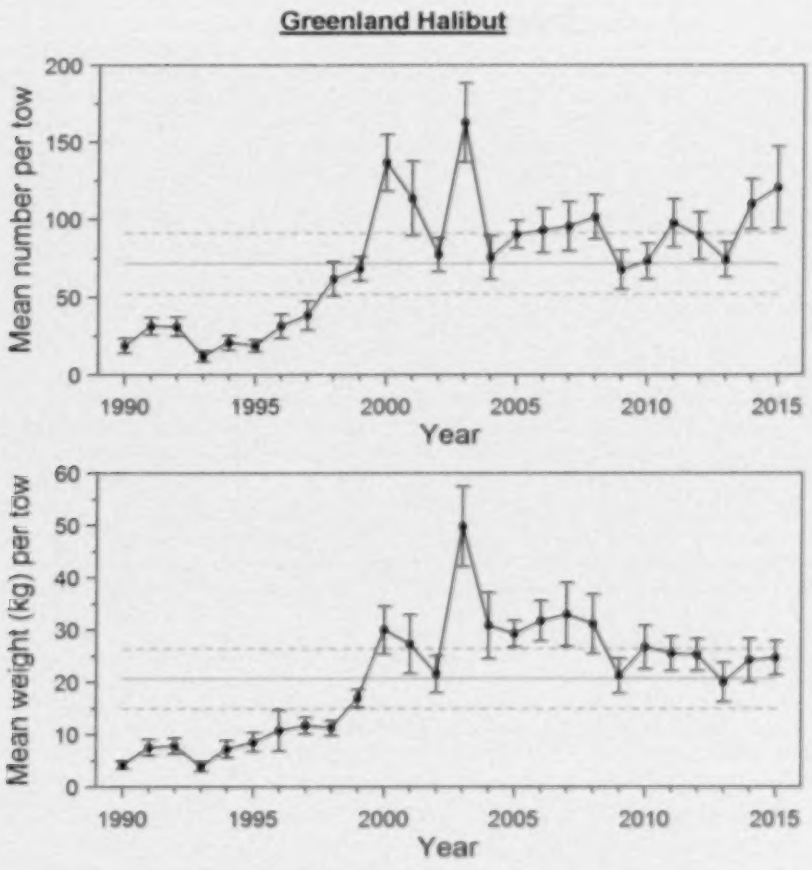


Figure 25. Mean numbers and mean weights per 15 minutes tow observed during the survey for Greenland Halibut in 4RST. Error bars indicate the 95% confidence interval and the horizontal lines indicate the mean of the 1990-2014 period (solid line) and upper and lower reference (see text) limits (dashed lines).

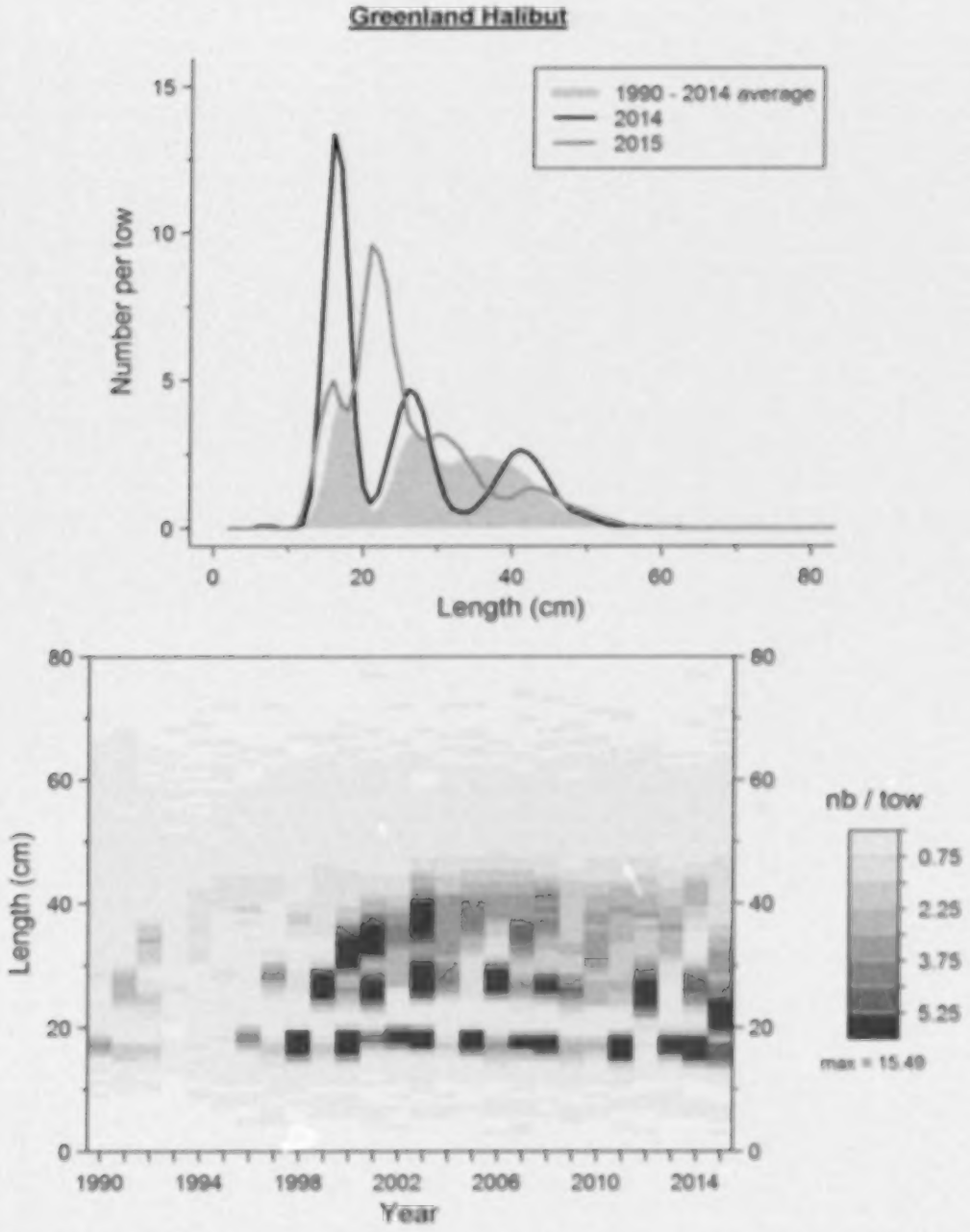


Figure 26. Length frequency distributions (mean number per 15 minutes tow) observed during the survey for Greenland Halibut in 4RST.

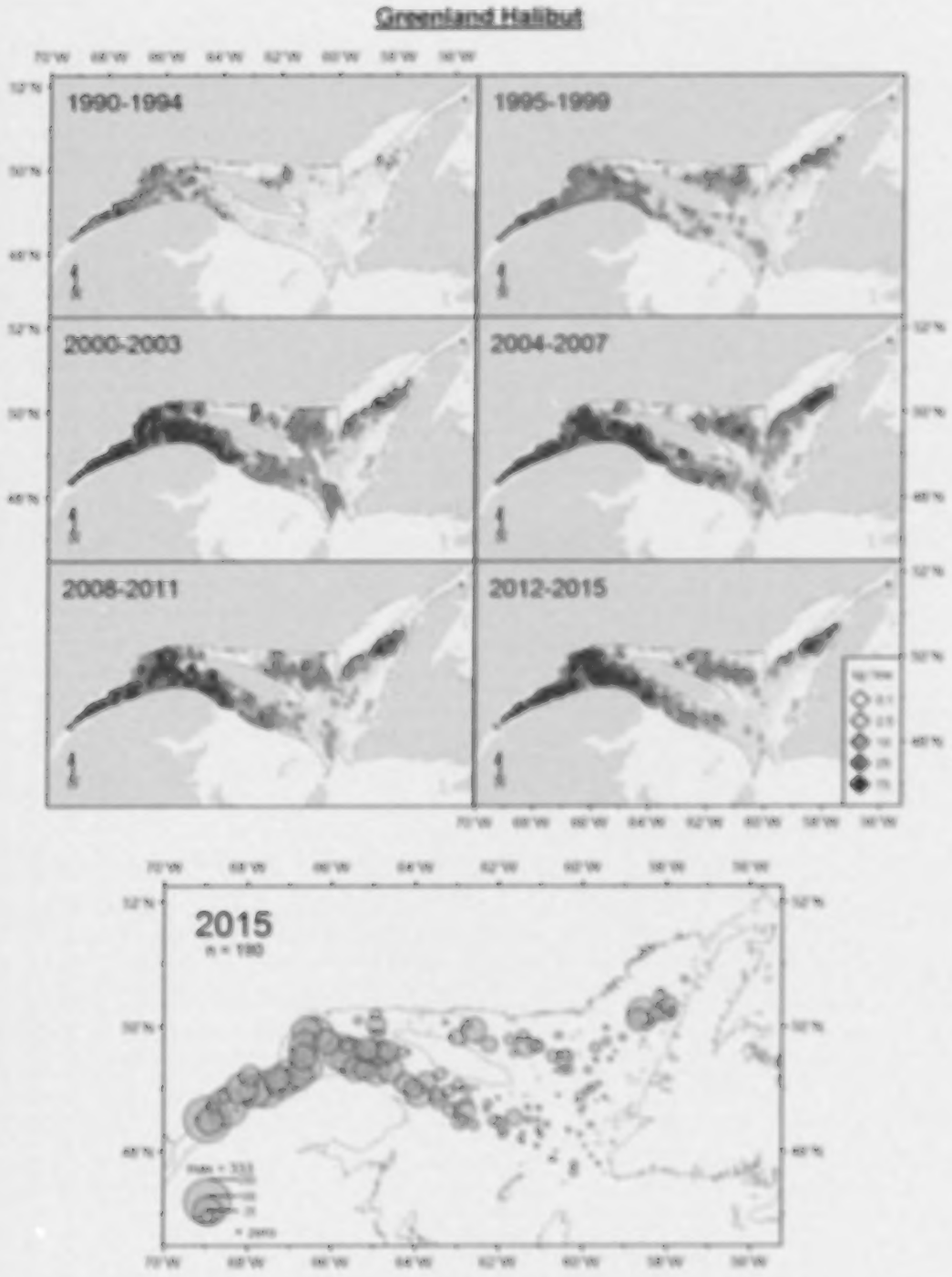


Figure 27. Greenland Halibut catch rates (kg/15 minutes tow) distribution.

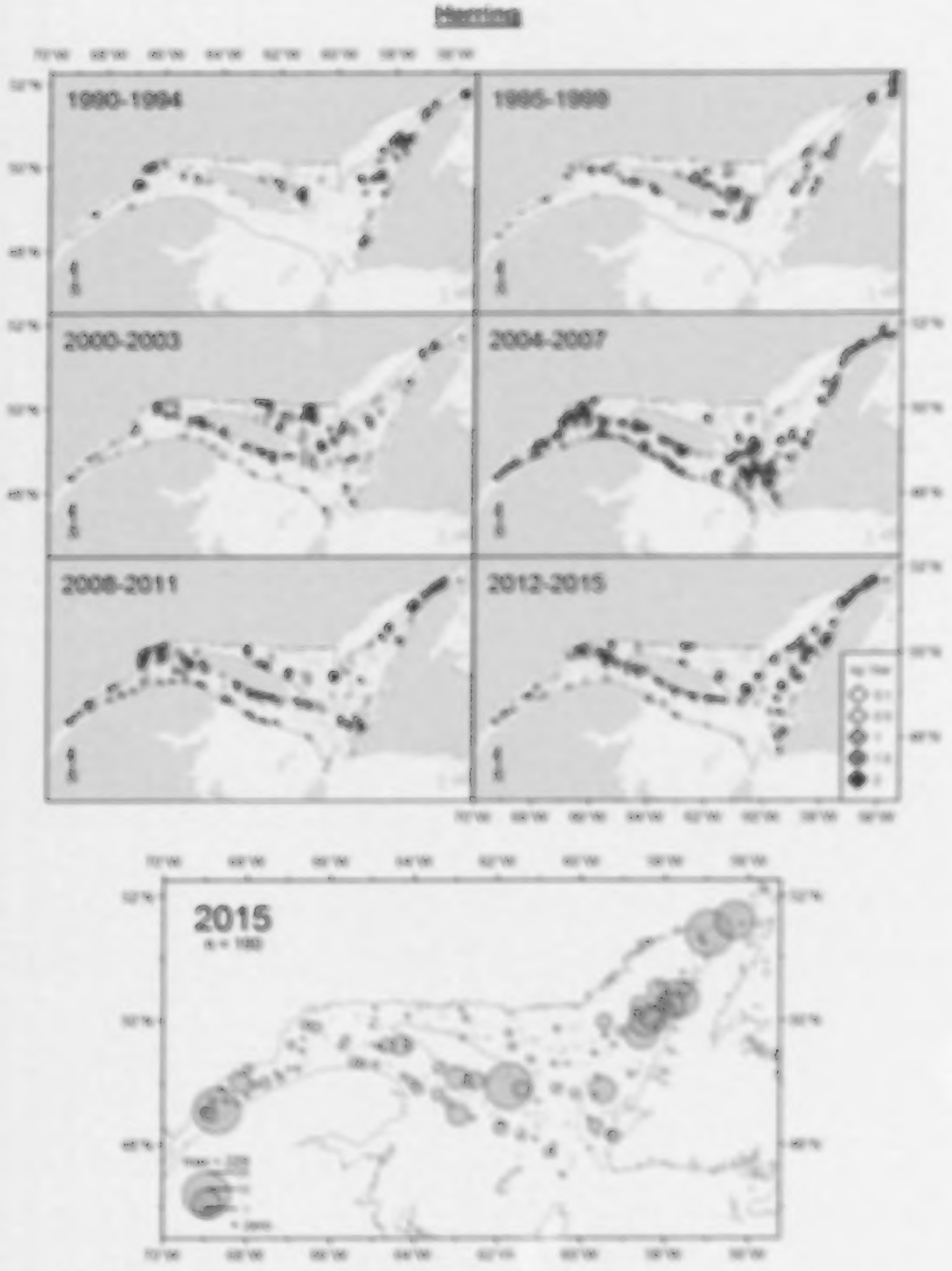


Figure 28. Herring catch rates (kg/15 minutes tow) distribution.

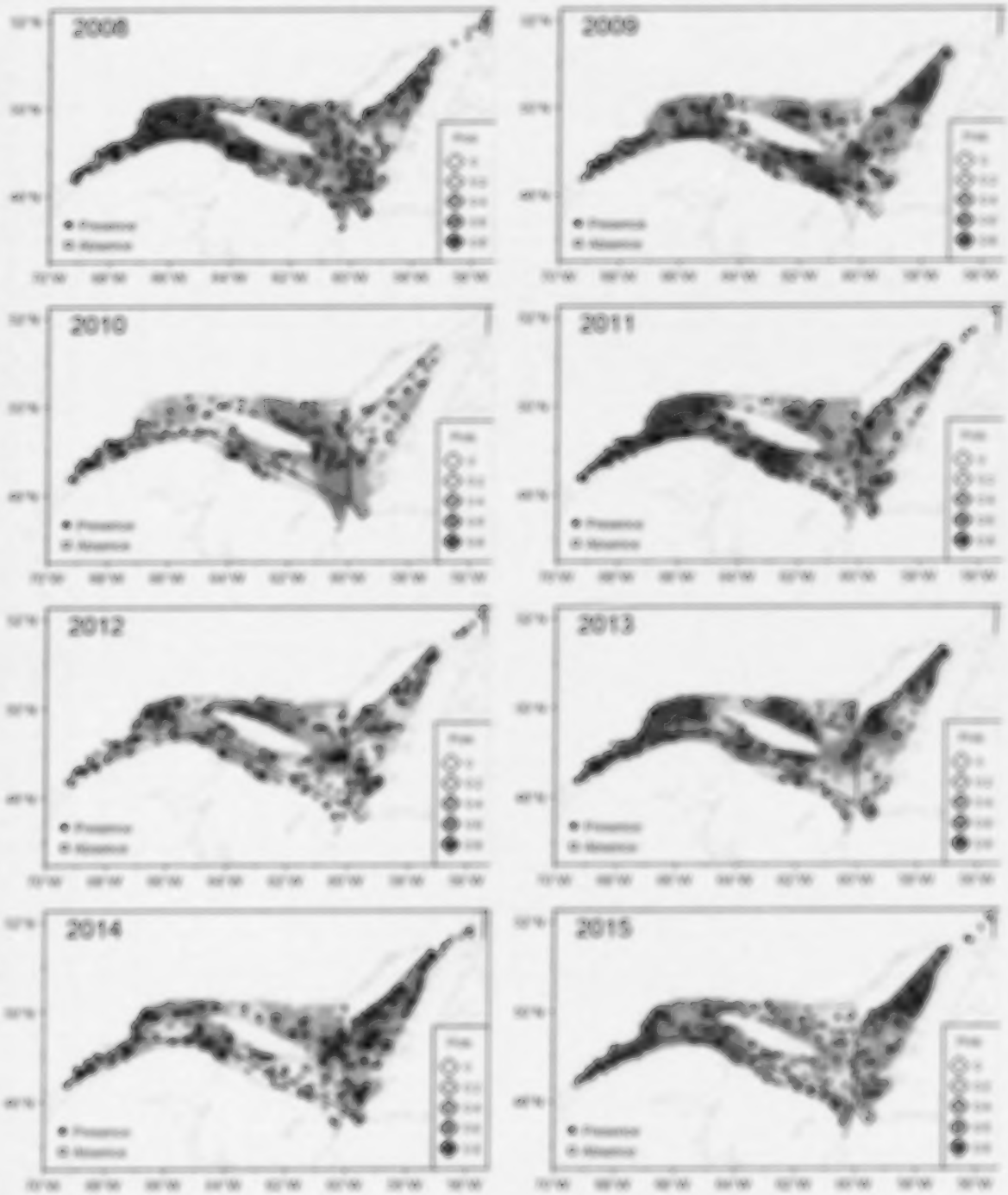


Figure 29. Probabilities areas (%) associated with the presence of Herring.

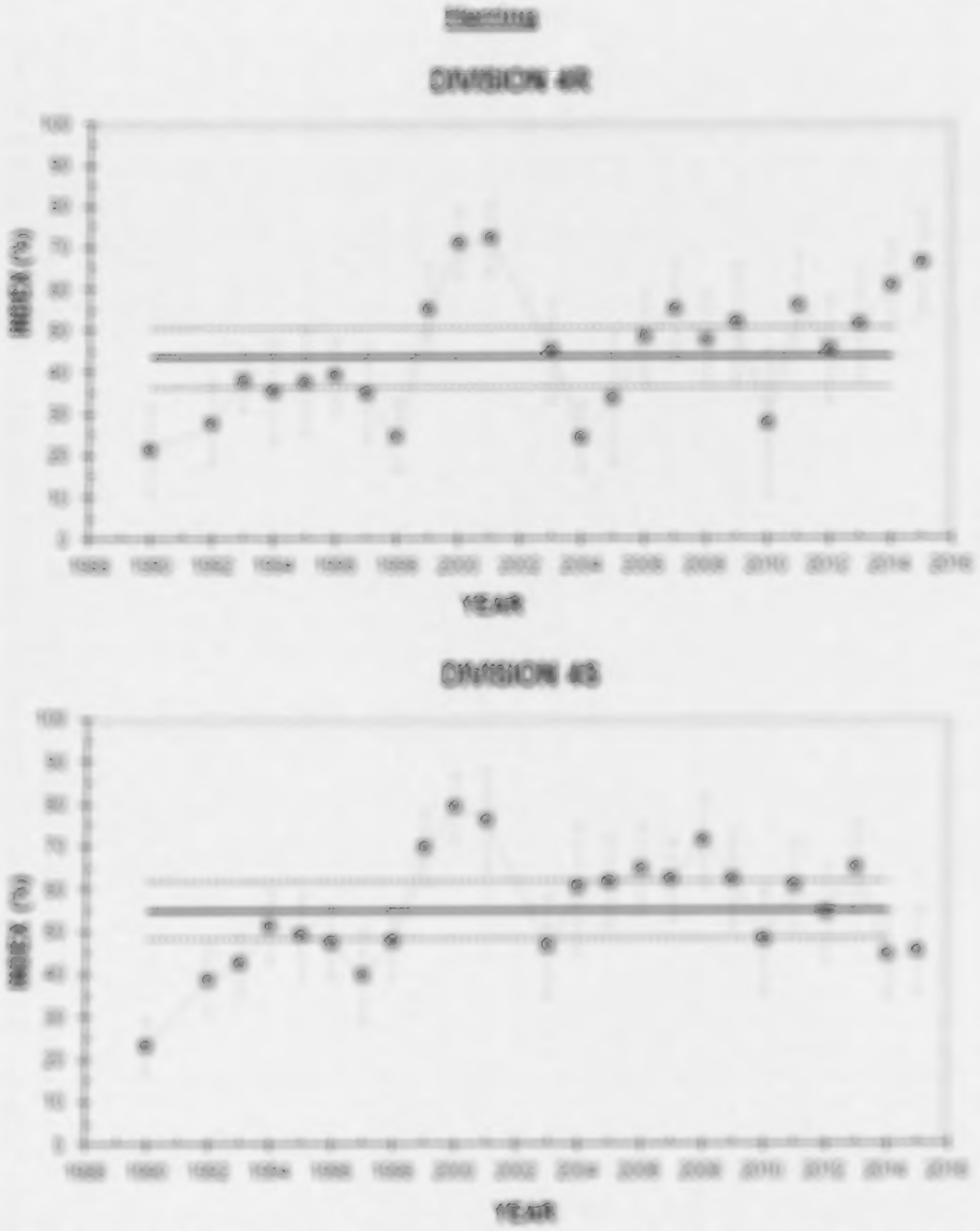


Figure 30. Mean probabilities of finding Herring in NAFO Divisions 4R and 4S. Error bars indicate the 95% confidence interval and the horizontal lines indicate the mean of the 1990-2016 period (solid line) and upper and lower reference (see text) limits (dashed lines).

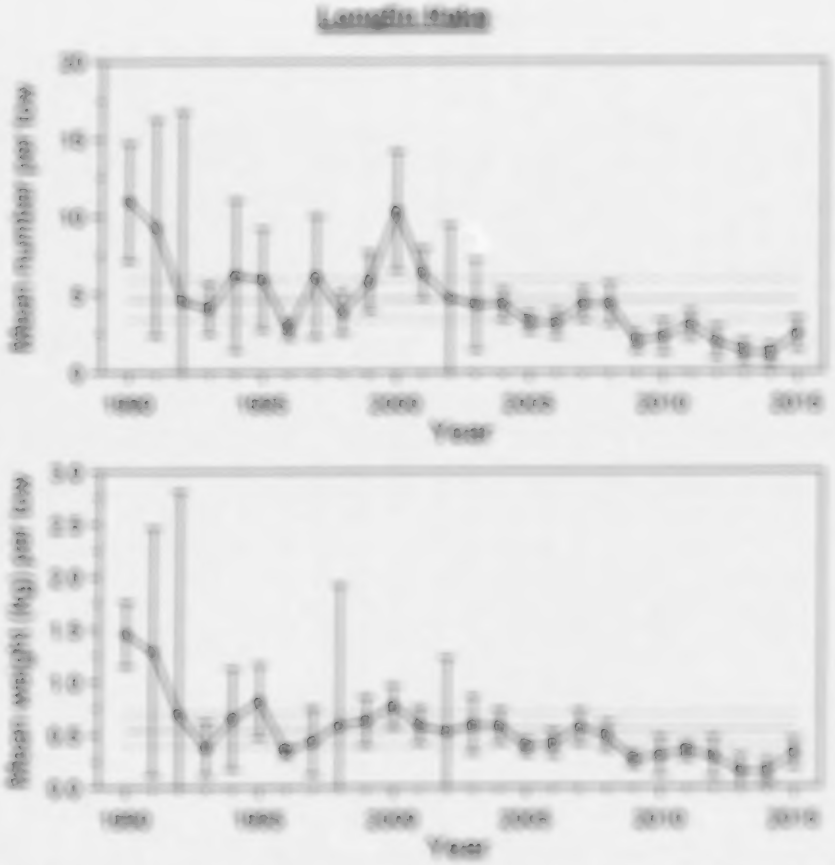


Figure 31: Mean numbers and mean weights per 15 minutes tow observed during the survey for Longfin Inlet in 8612. Error bars indicate the 95% confidence interval and the horizontal lines indicate the mean of the 1990-2014 period (solid line) and upper and lower reference (see text) limits (dashed lines).

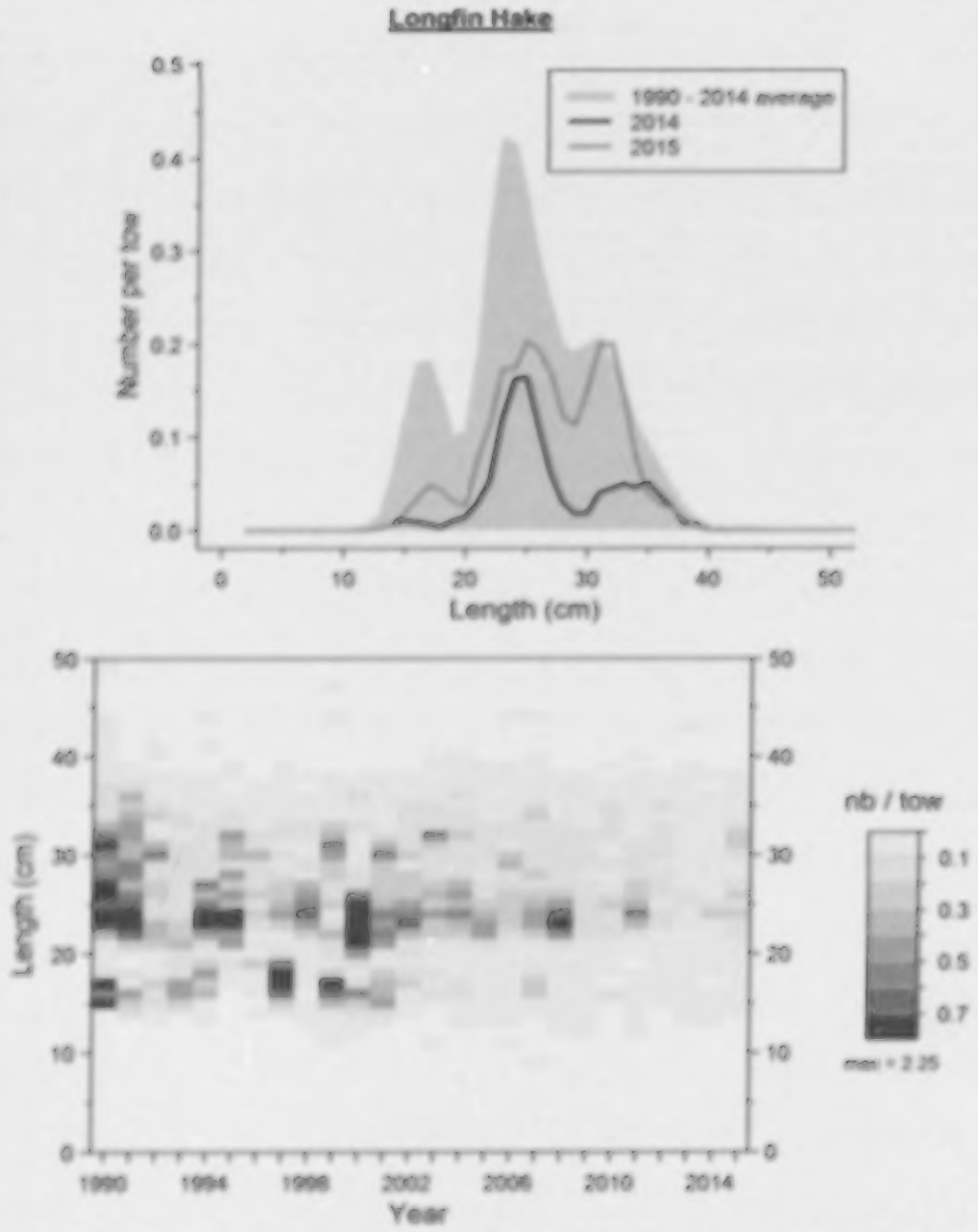


Figure 32. Length frequency distributions (mean number per 15 minutes tow) observed during the survey for Longfin Hake in 4RST.

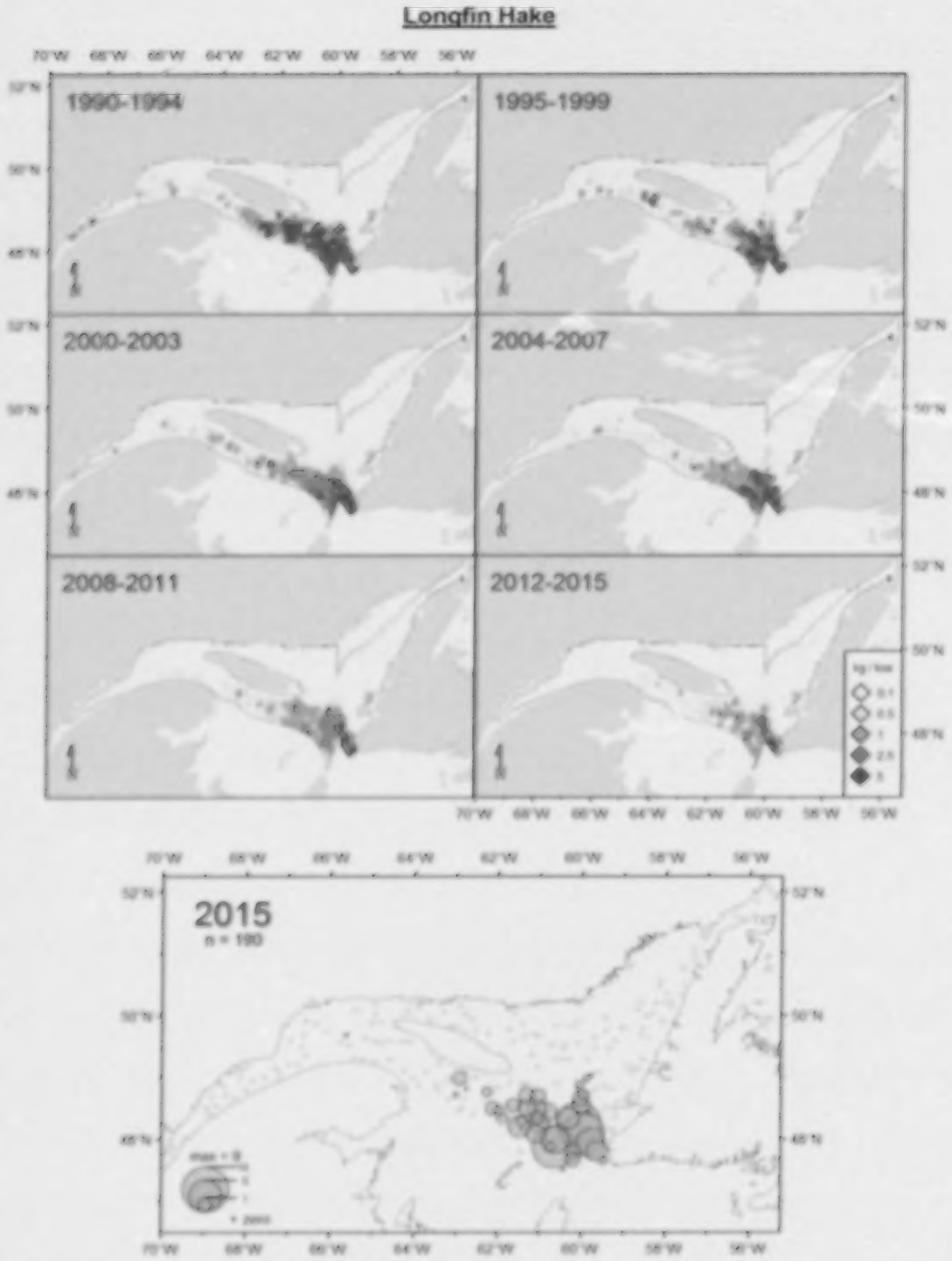


Figure 33. Longfin Hake catch rates (kg/15 minutes tow) distribution.

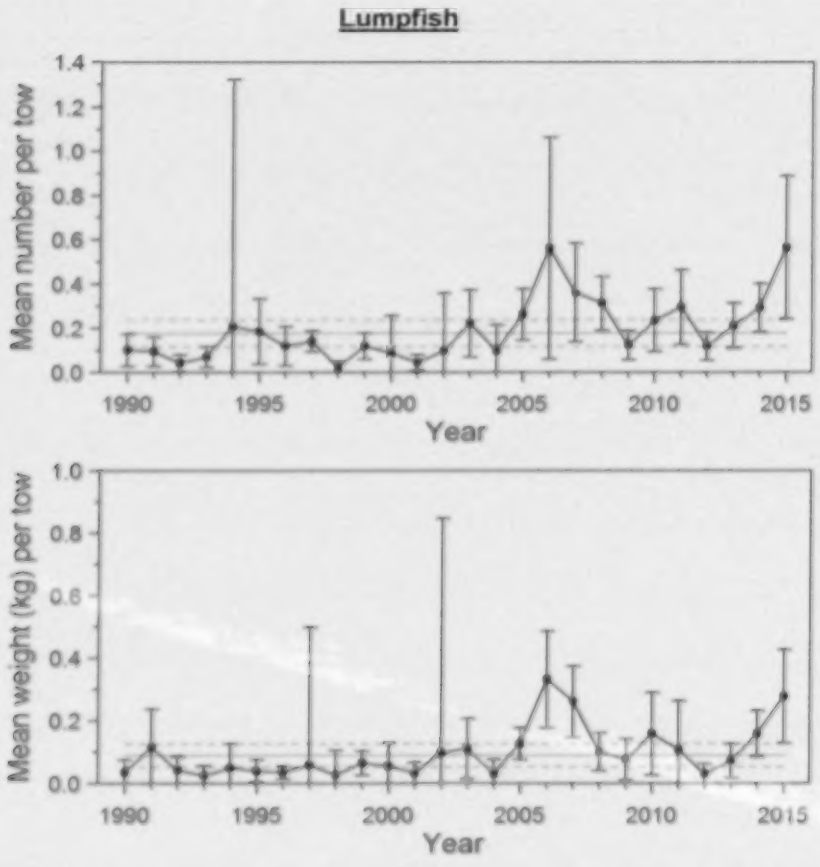


Figure 34. Mean numbers and mean weights per 15 minutes tow observed during the survey for Lumpfish in 4RST. Error bars indicate the 95% confidence interval and the horizontal lines indicate the mean of the 1990-2014 period (solid line) and upper and lower reference (see text) limits (dashed lines).

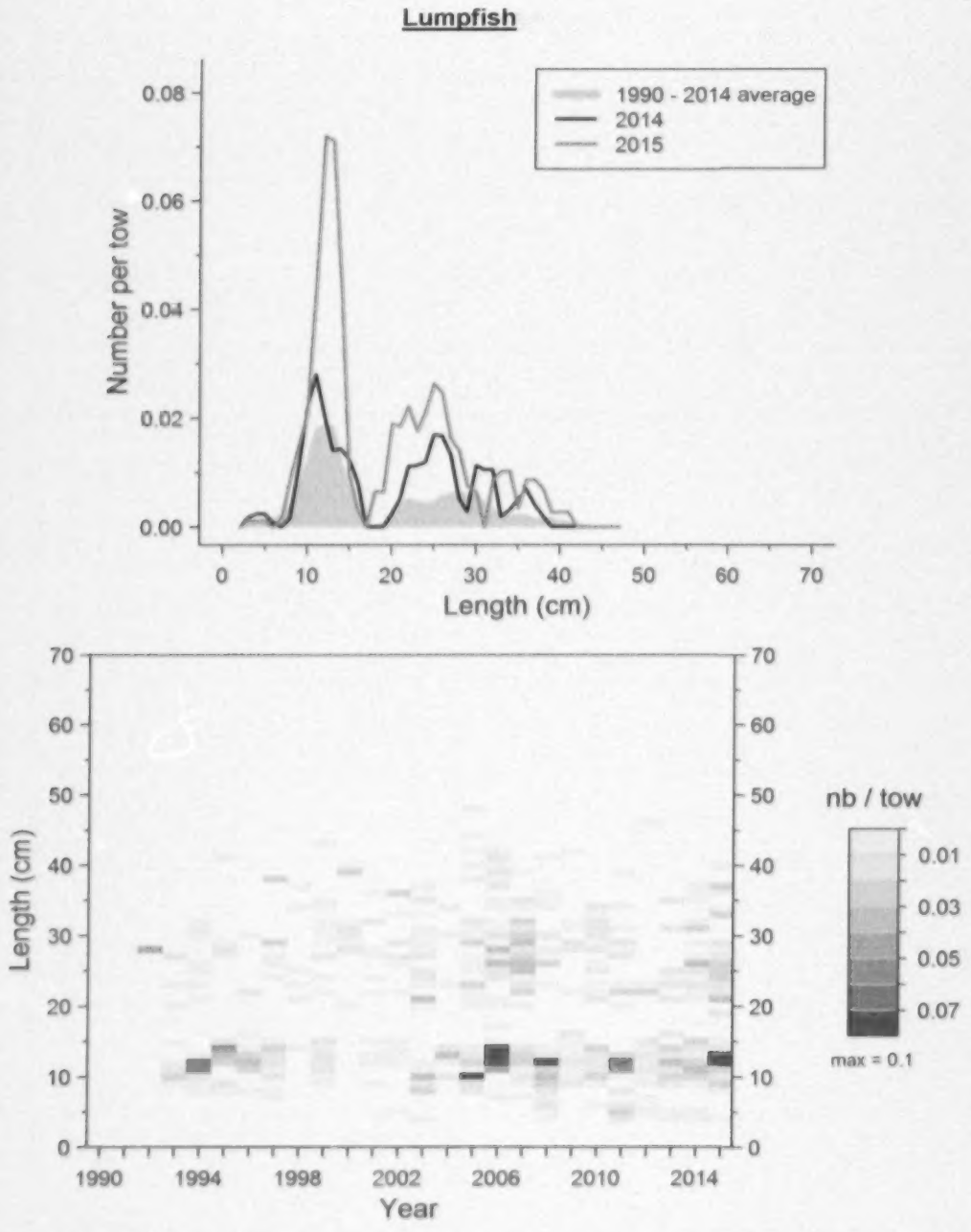


Figure 35. Length frequency distributions (mean number per 15 minutes tow) observed during the survey for Lumpfish in 4RST.

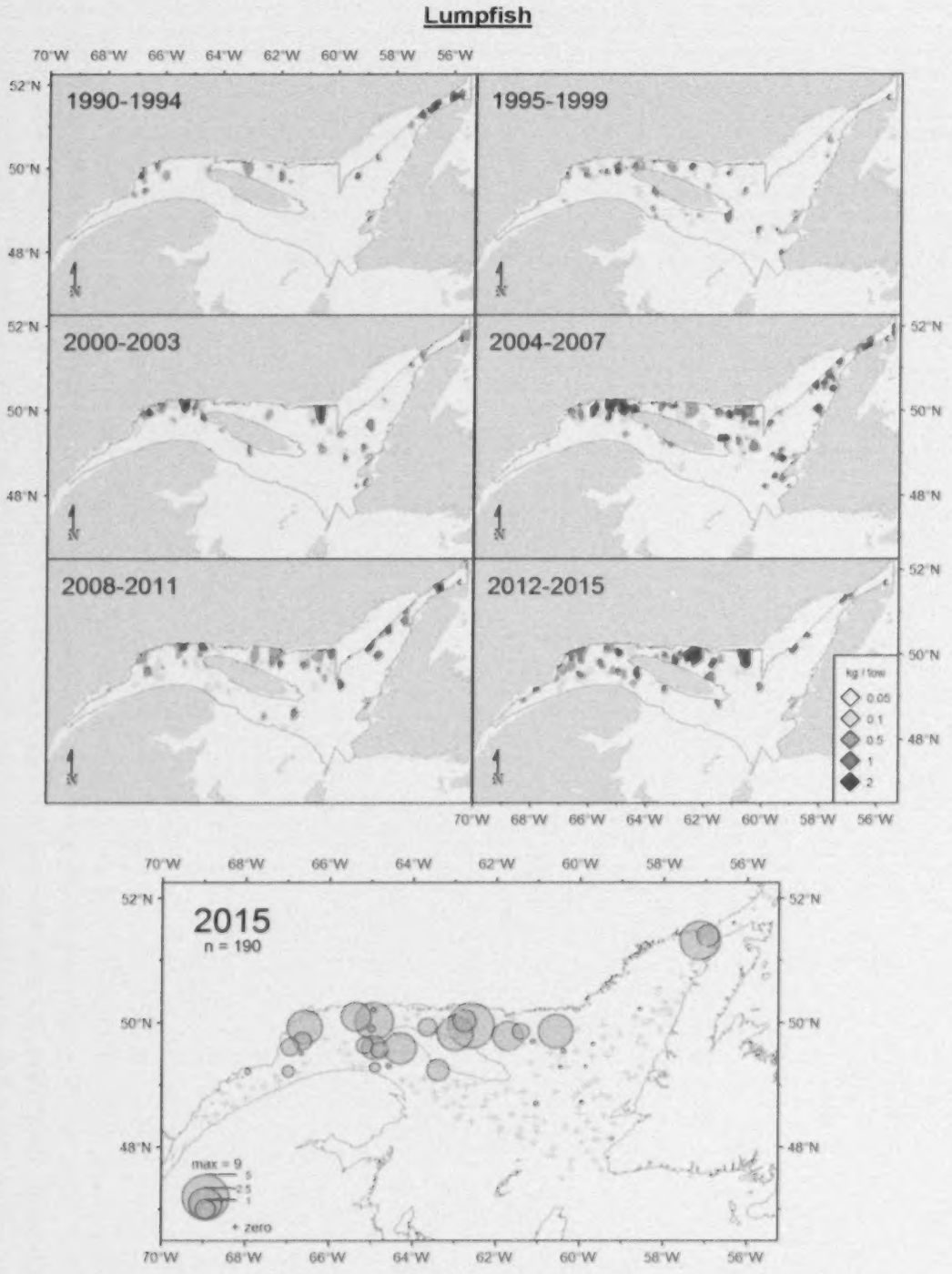


Figure 36. Lumpfish catch rates (kg/15 minutes tow) distribution.

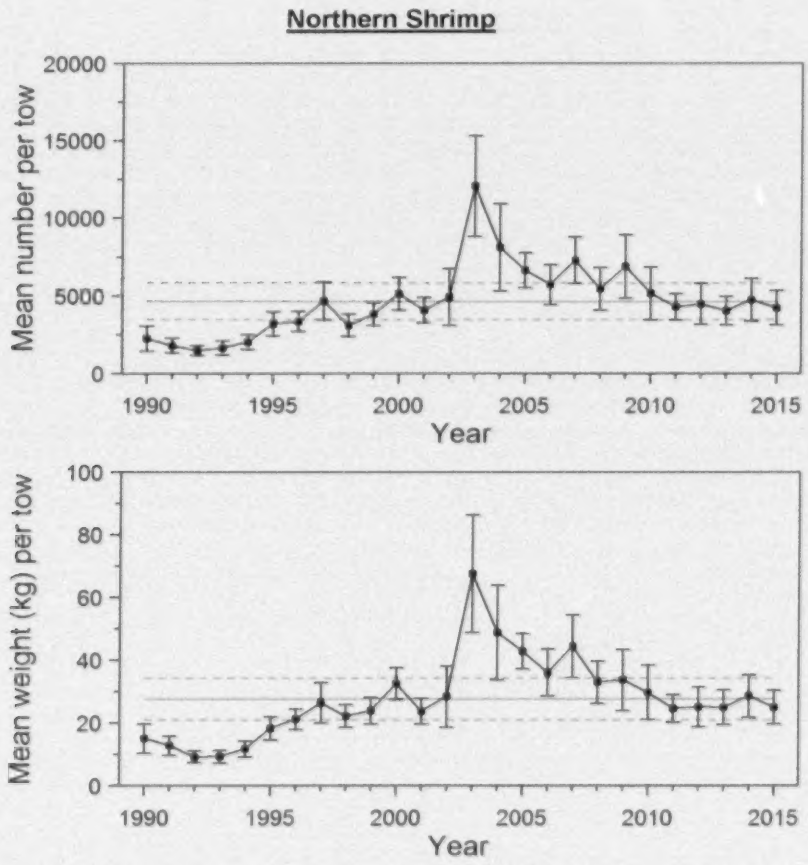


Figure 37. Mean numbers and mean weights per 15 minutes tow observed during the survey for Northern Shrimp in 4RST. Error bars indicate the 95% confidence interval and the horizontal lines indicate the mean of the 1990-2014 period (solid line) and upper and lower reference (see text) limits (dashed lines).

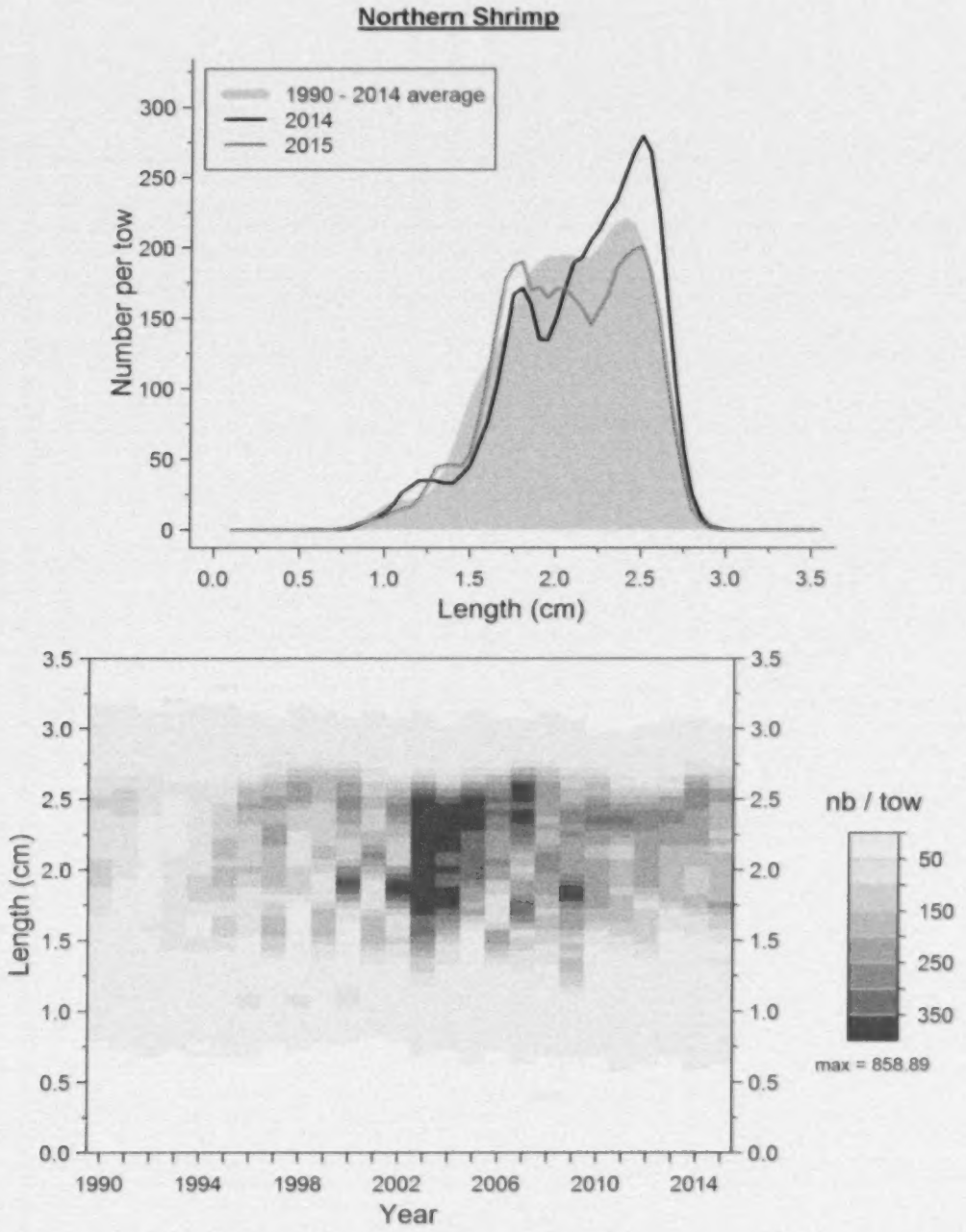


Figure 38. Carapace length frequency distributions (mean number per 15 minutes tow) observed during the survey for Northern Shrimp in 4RST.

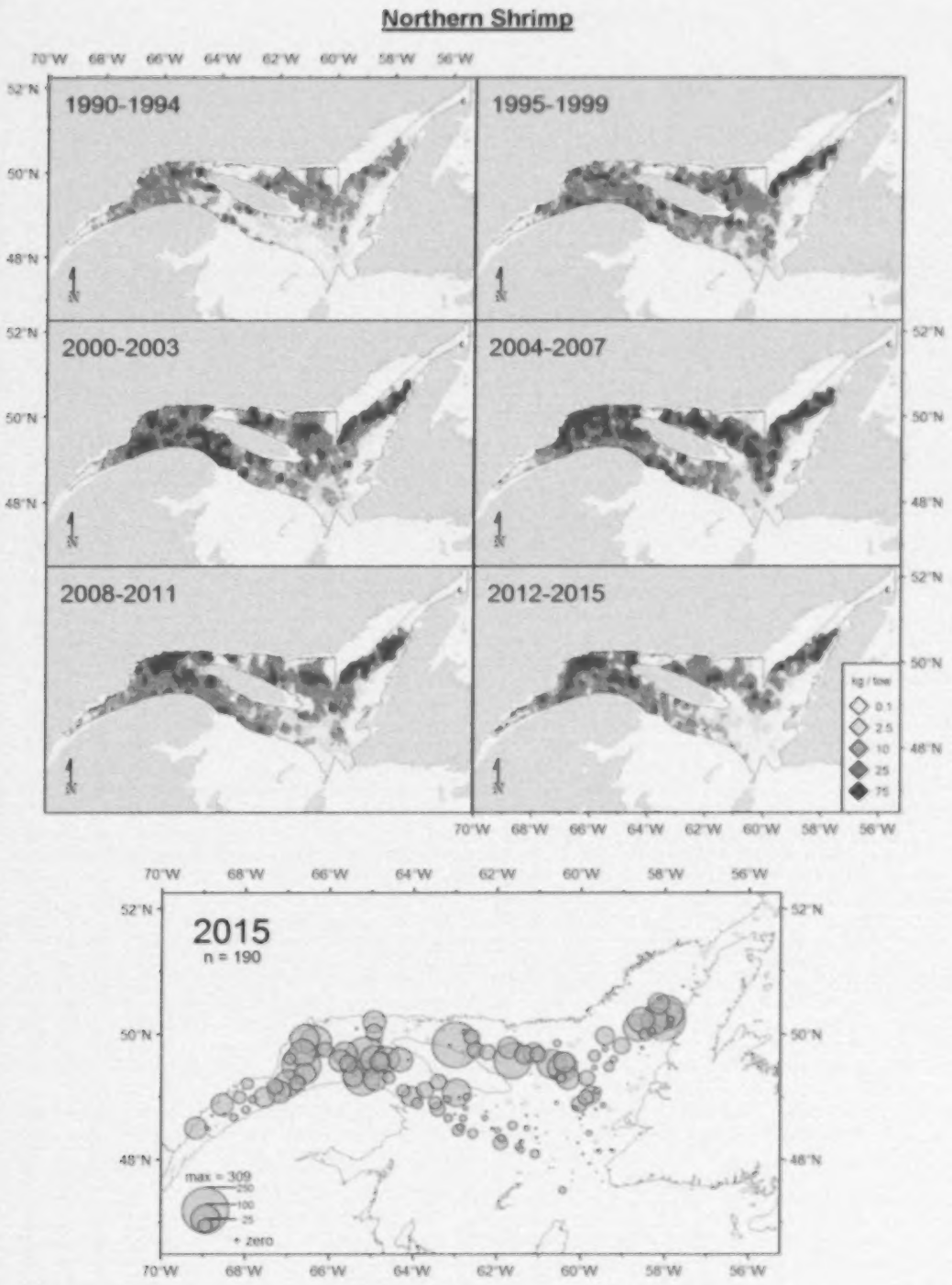


Figure 39. Northern Shrimp catch rates (kg/15 minutes tow) distribution.

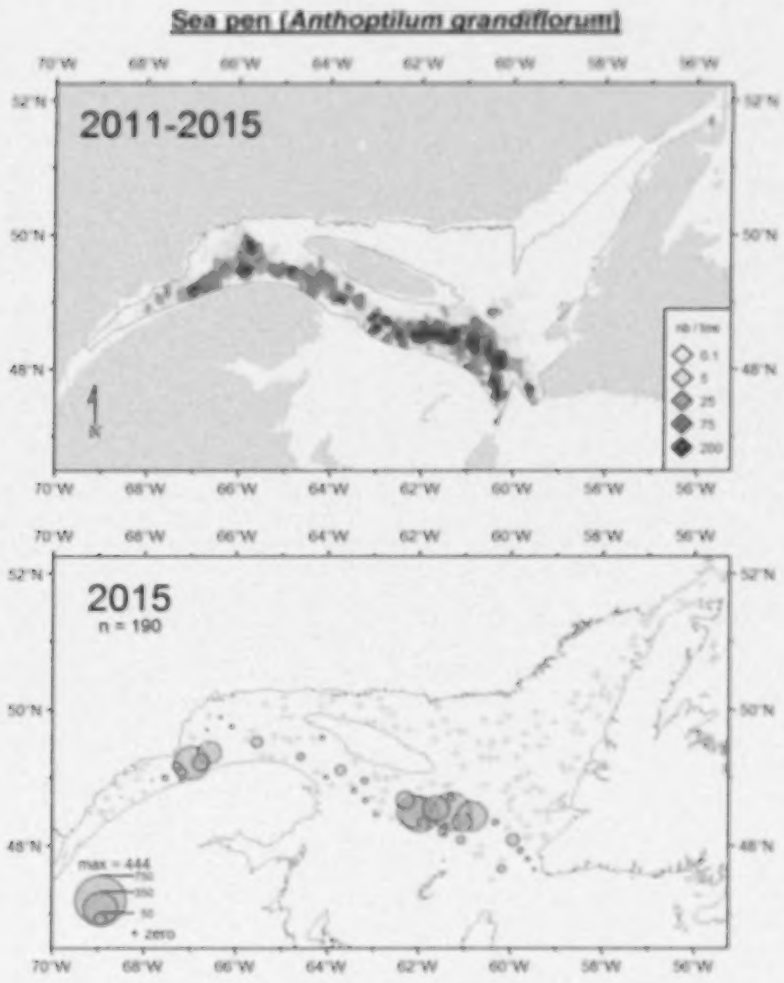


Figure 40. Sea pen Anthoptilum grandiflorum catch rates (nb/15 minutes tow) distribution.

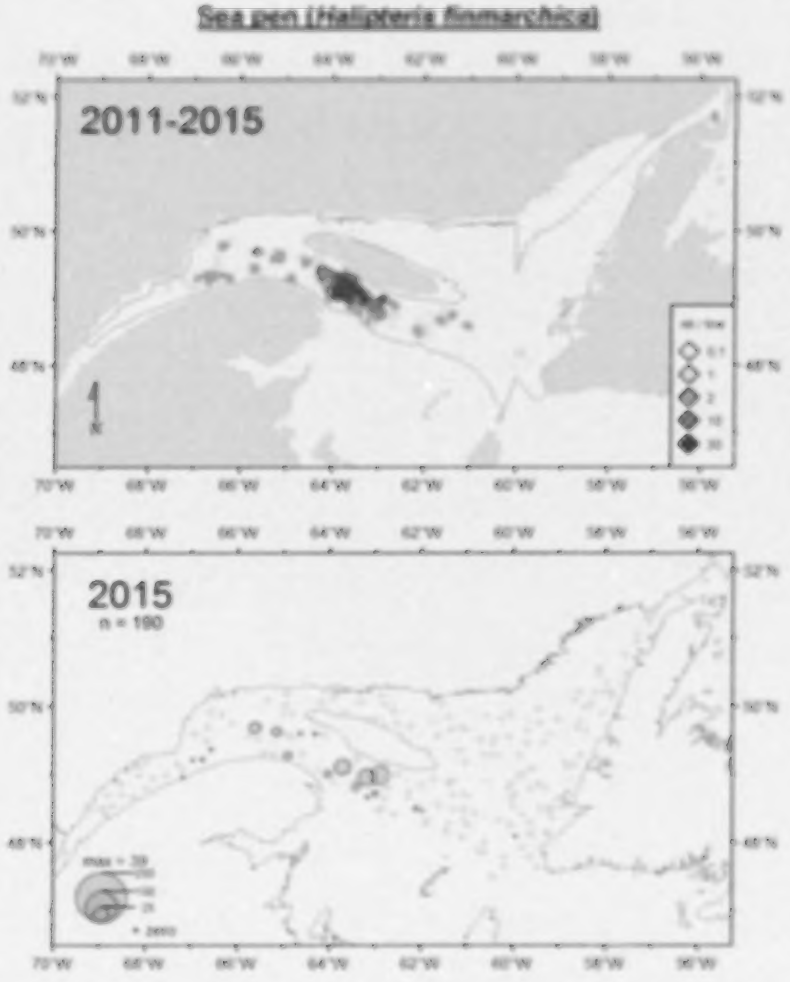


Figure 41. Sea pen Halipteris finmarchica catch rates (nb/15 minutes tow) distribution.

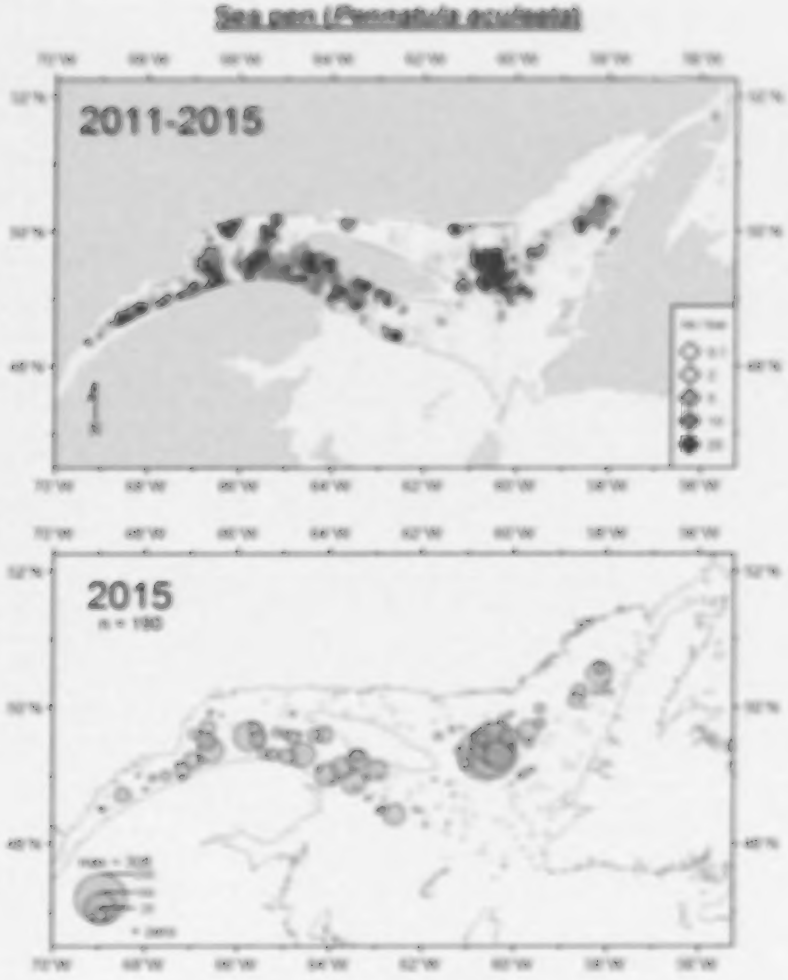


Figure 42. Sea pen Pennatula aculeata catch rates (nb/15 minutes tow) distribution.

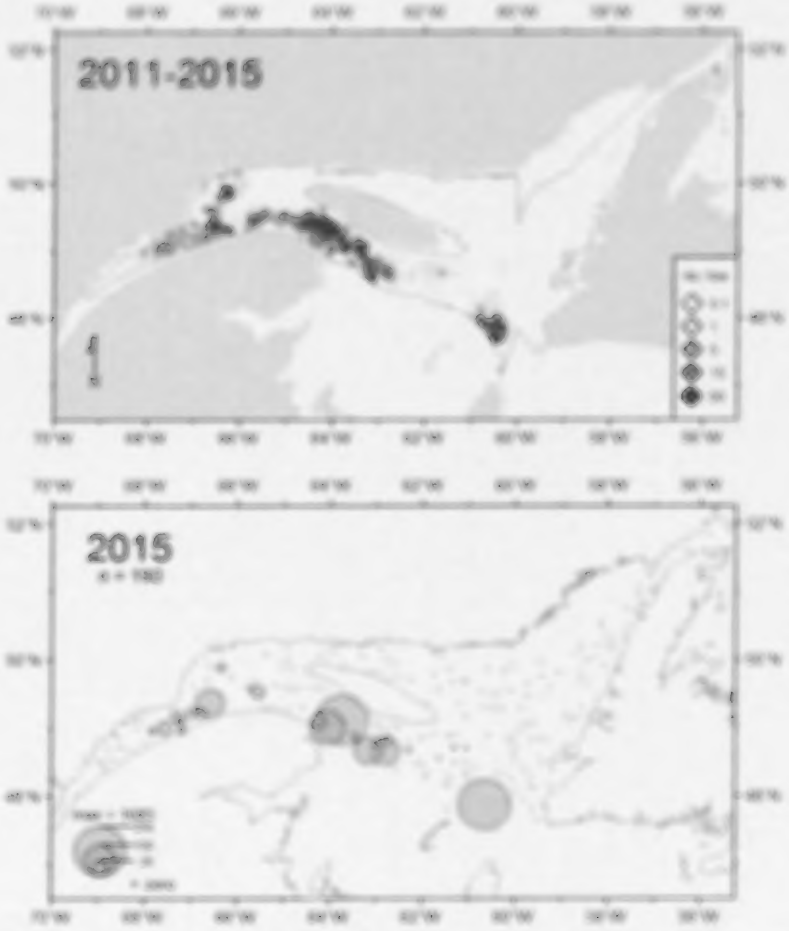


Figure 43. Sea pen Pennatula grandis catch rates (nb/15 minutes tow) distribution.

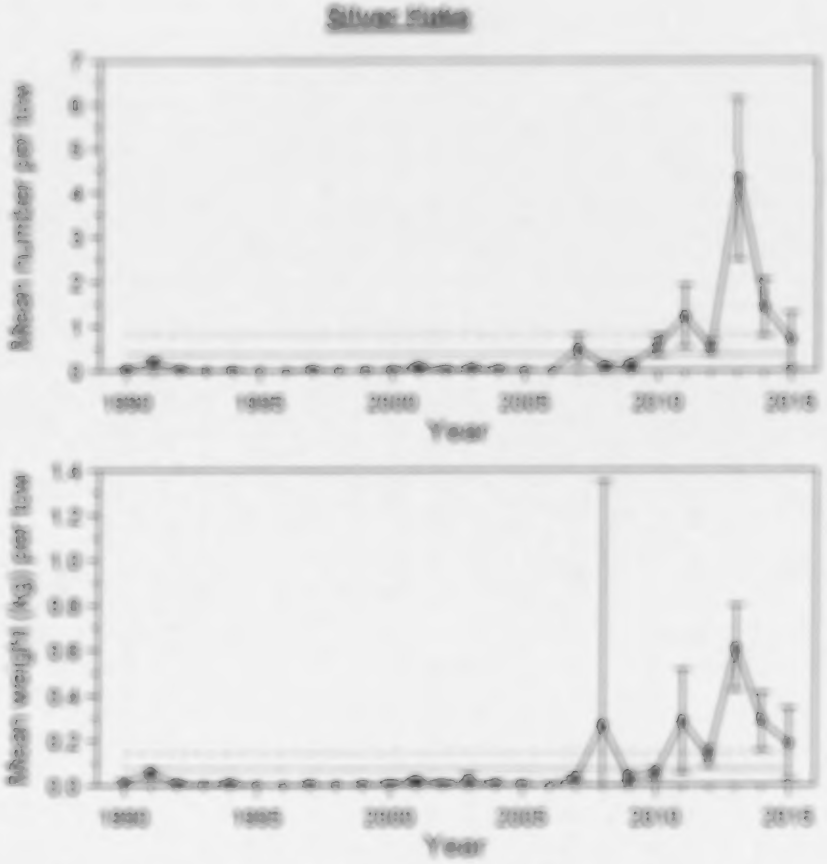


Figure 44. Mean numbers and mean weights per 15 minutes tow observed during the survey for Silver Hake in NRST. Error bars indicate the 95% confidence interval and the horizontal lines indicate the mean of the 1995-2014 period (solid line) and upper and lower reference (see text) limits (dashed lines).

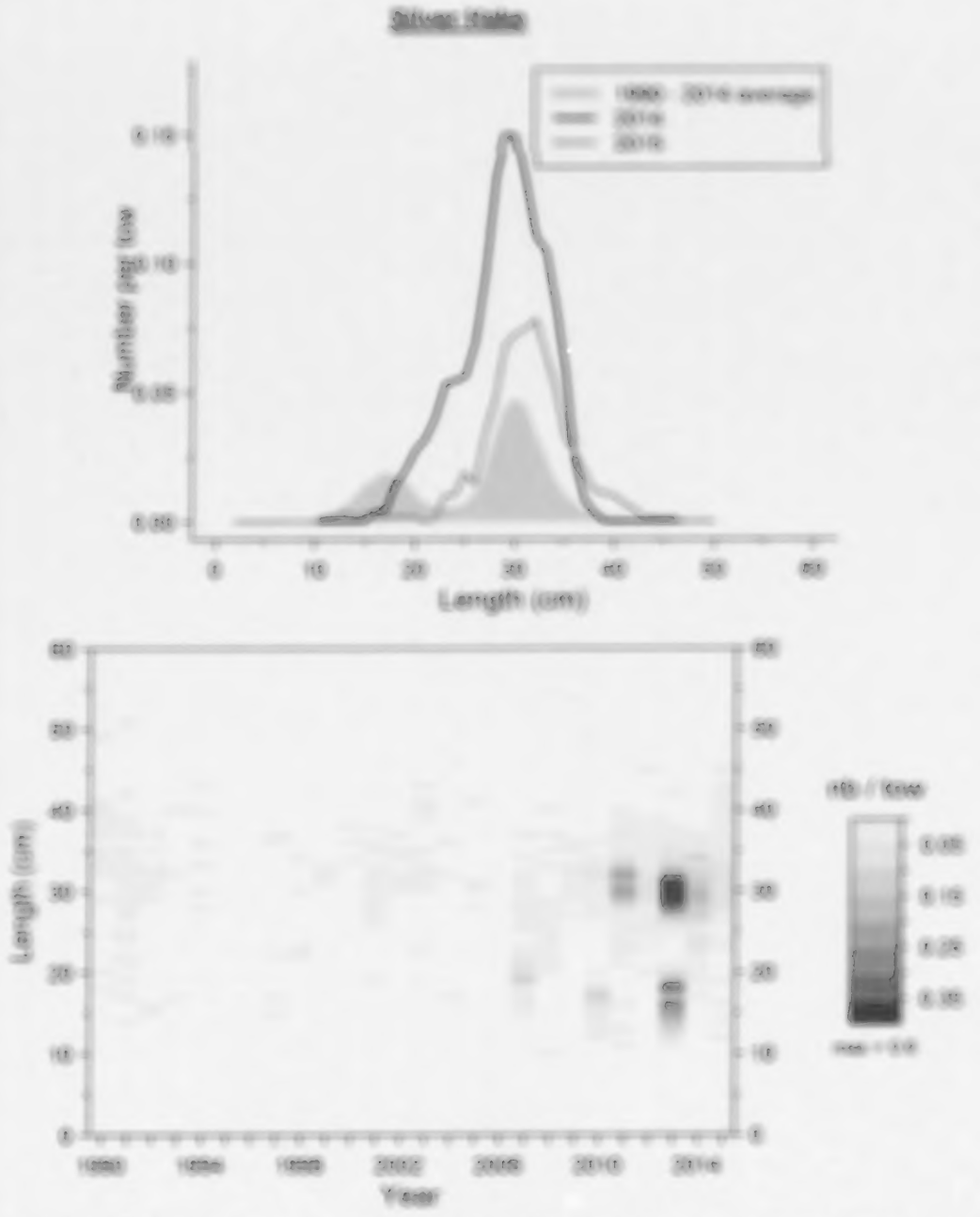


Figure 65. Length frequency distributions (mean number per 15 minutes tow) observed during the survey for Silver Hake in 4RS3Pn.

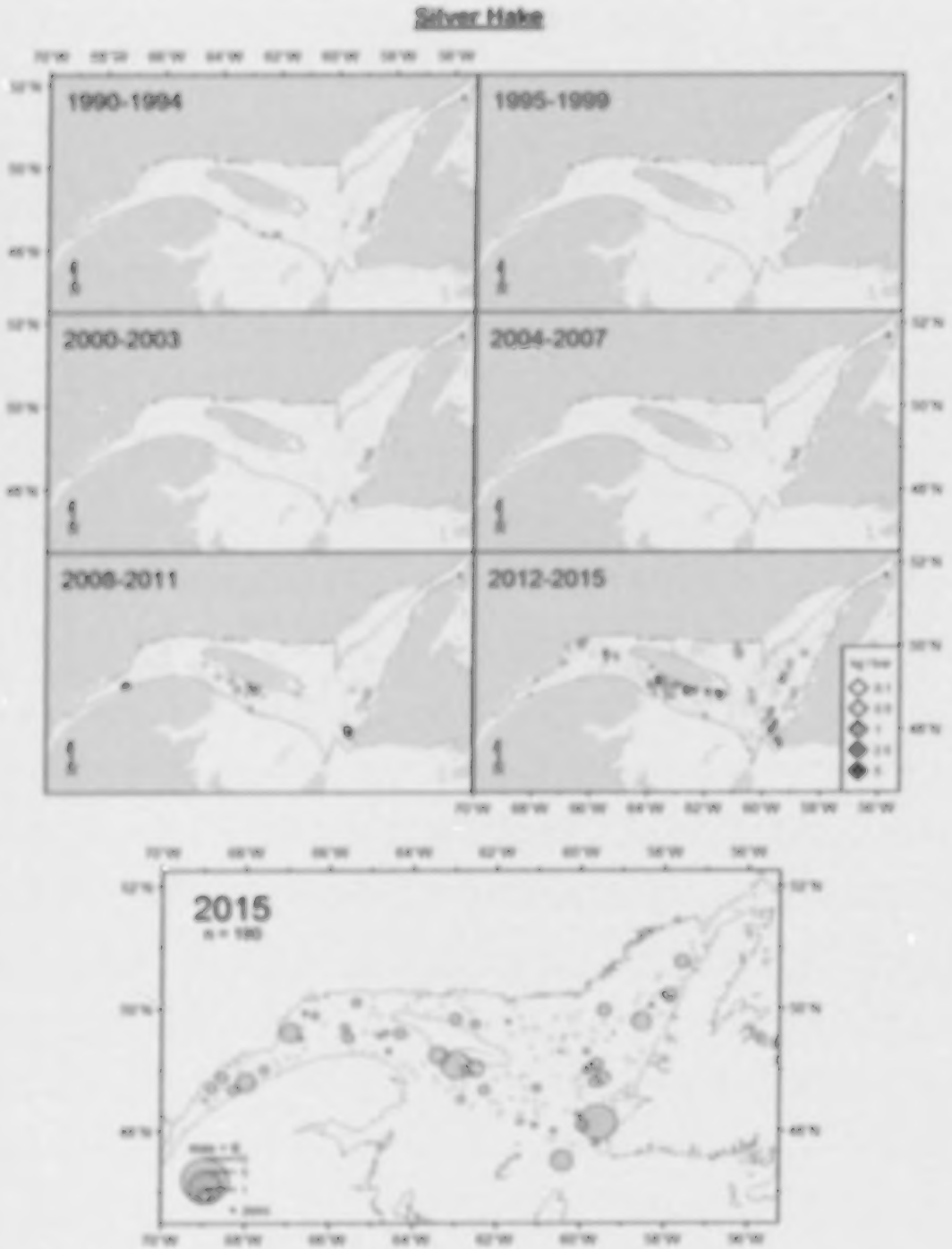


Figure 48. Silver Hake catch rates (kg/15 minutes tow) distribution.

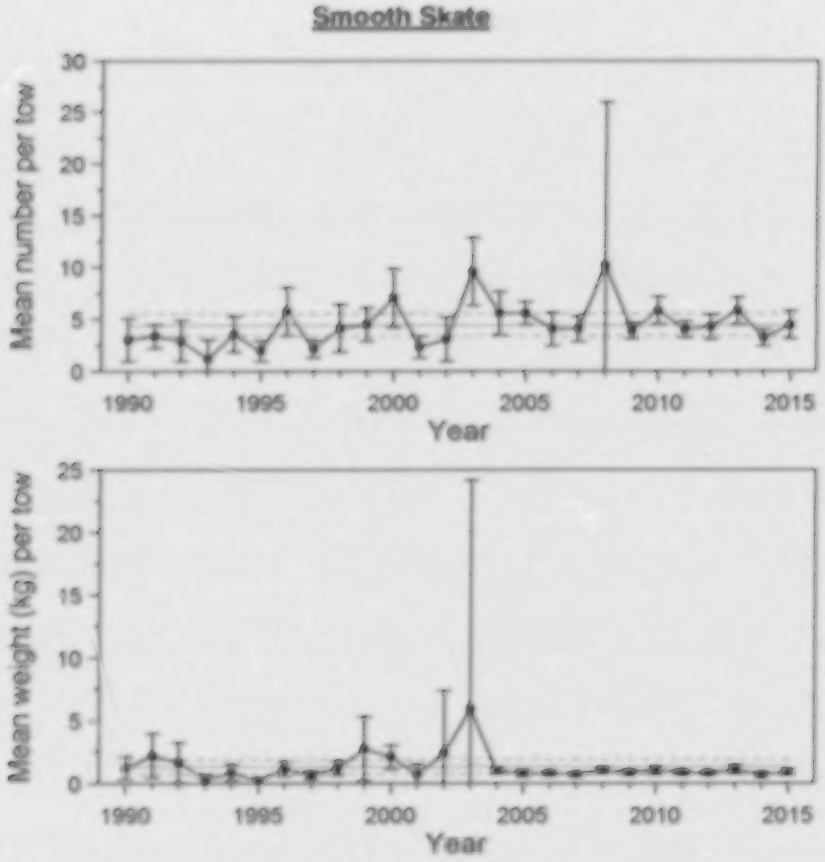


Figure 47. Mean numbers and mean weights per 15 minutes tow observed during the survey for Smooth Skate in 4RST. Error bars indicate the 95% confidence interval and the horizontal lines indicate the mean of the 1990-2014 period (solid line) and upper and lower reference (see text) limits (dashed lines).

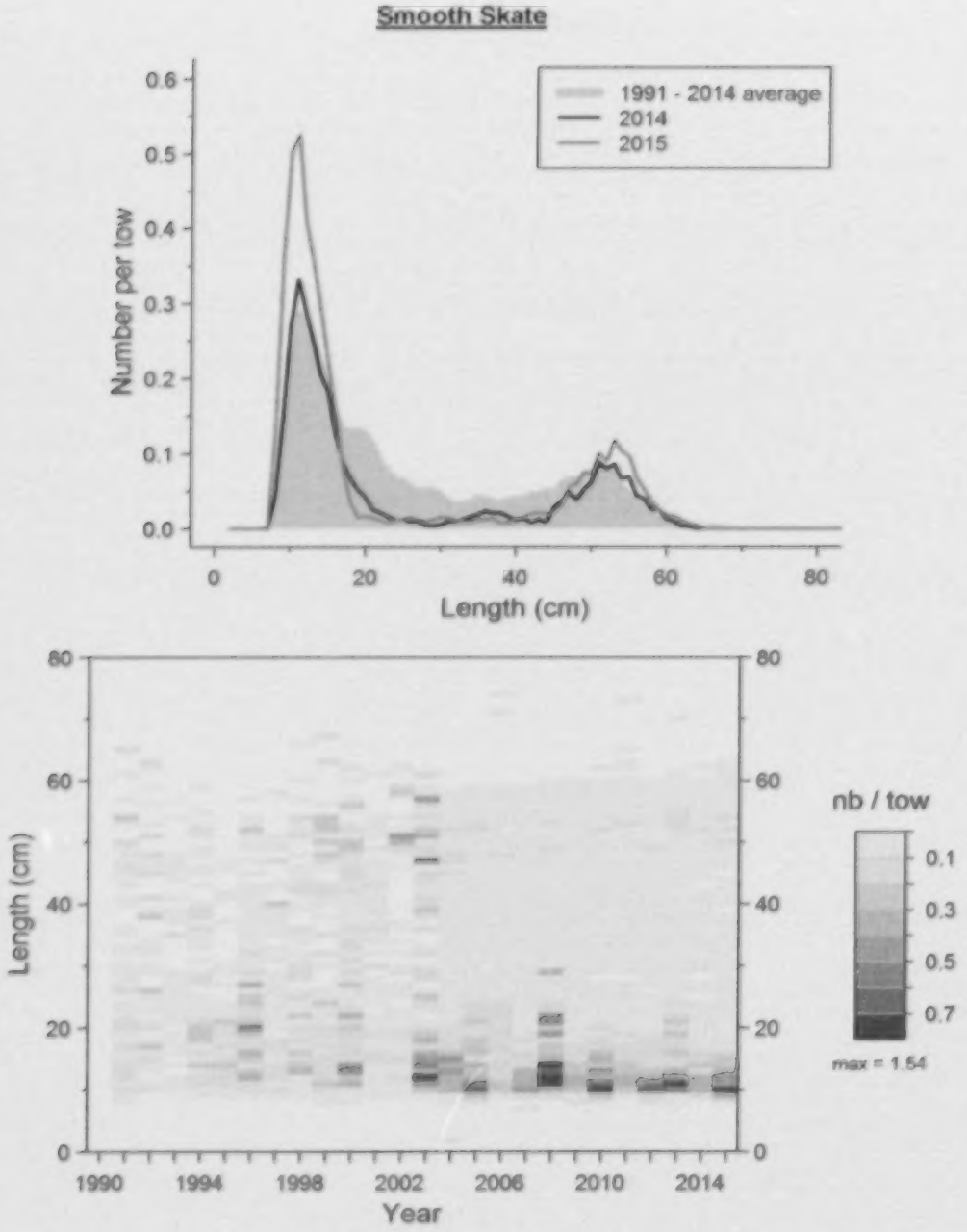


Figure 48. Length frequency distributions (mean number per 15 minutes tow) observed during the survey for Smooth Skate in 4RST.

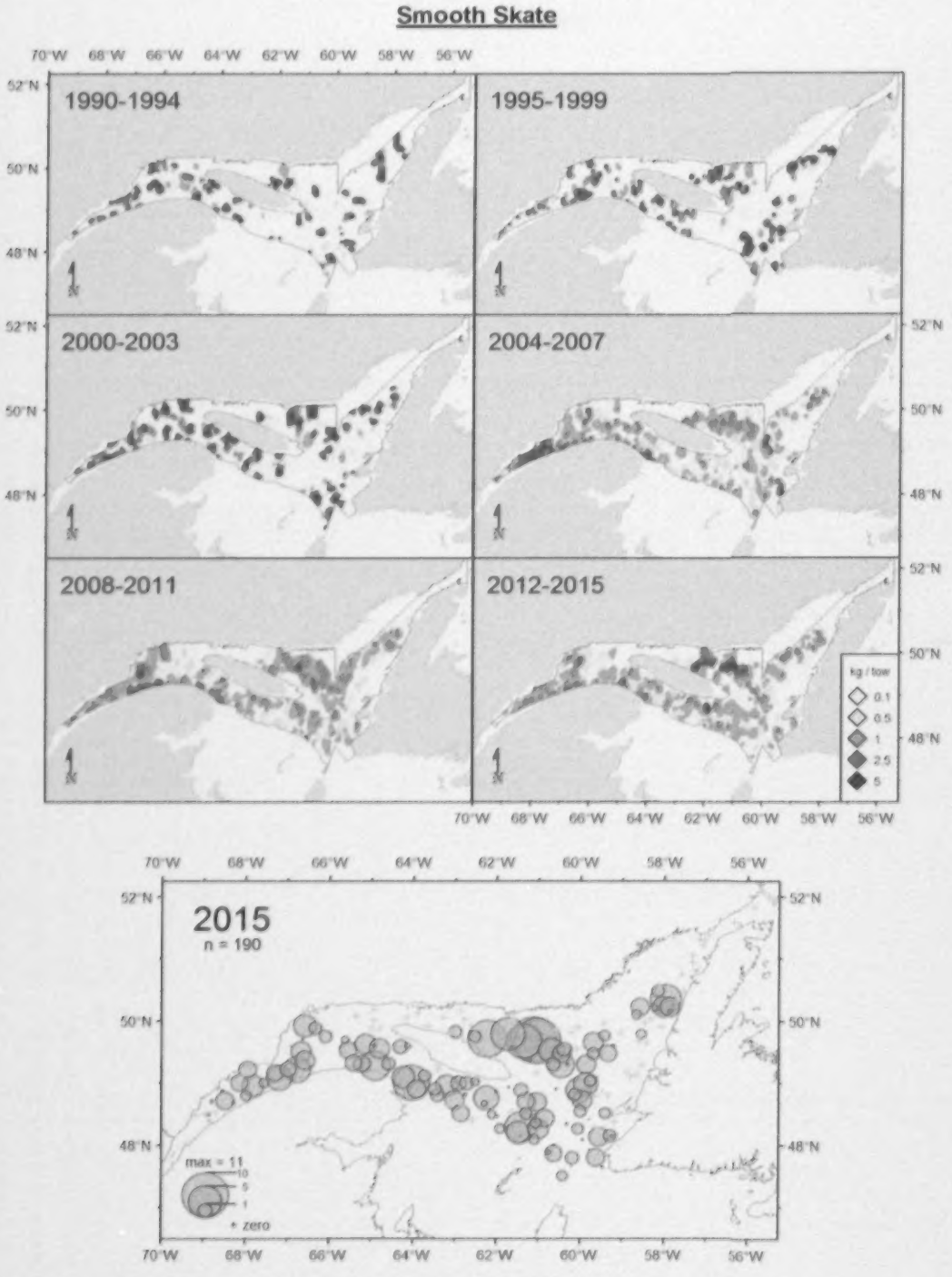


Figure 49. Smooth Skate catch rates (kg/15 minutes tow) distribution.

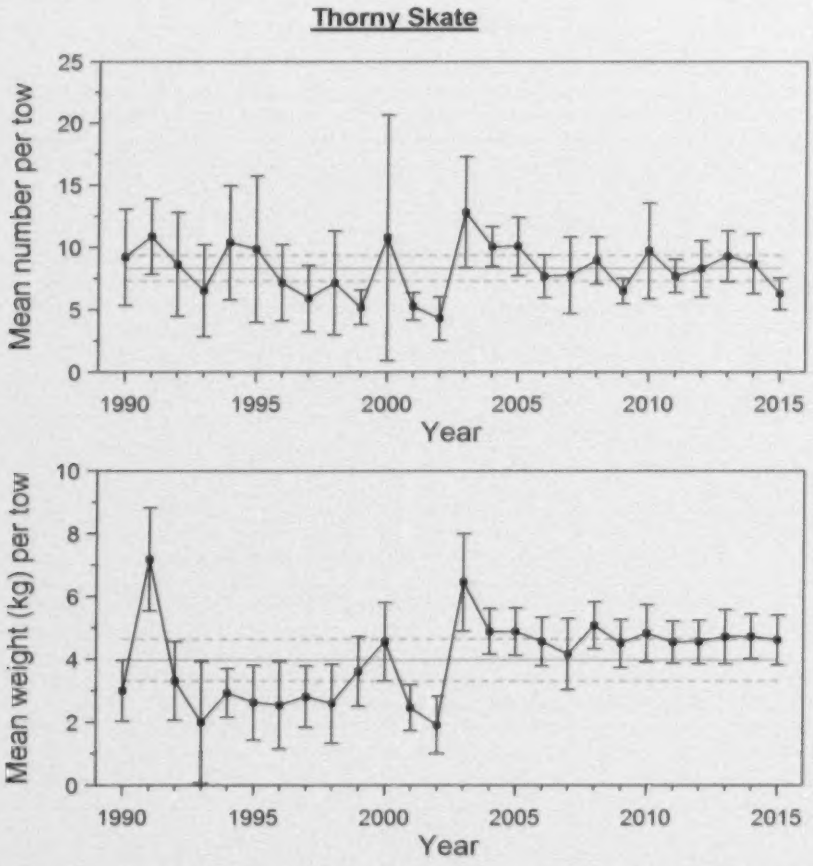


Figure 50. Mean numbers and mean weights per 15 minutes tow observed during the survey for Thorny Skate in 4RST. Error bars indicate the 95% confidence interval and the horizontal lines indicate the mean of the 1990-2014 period (solid line) and upper and lower reference (see text) limits (dashed lines).

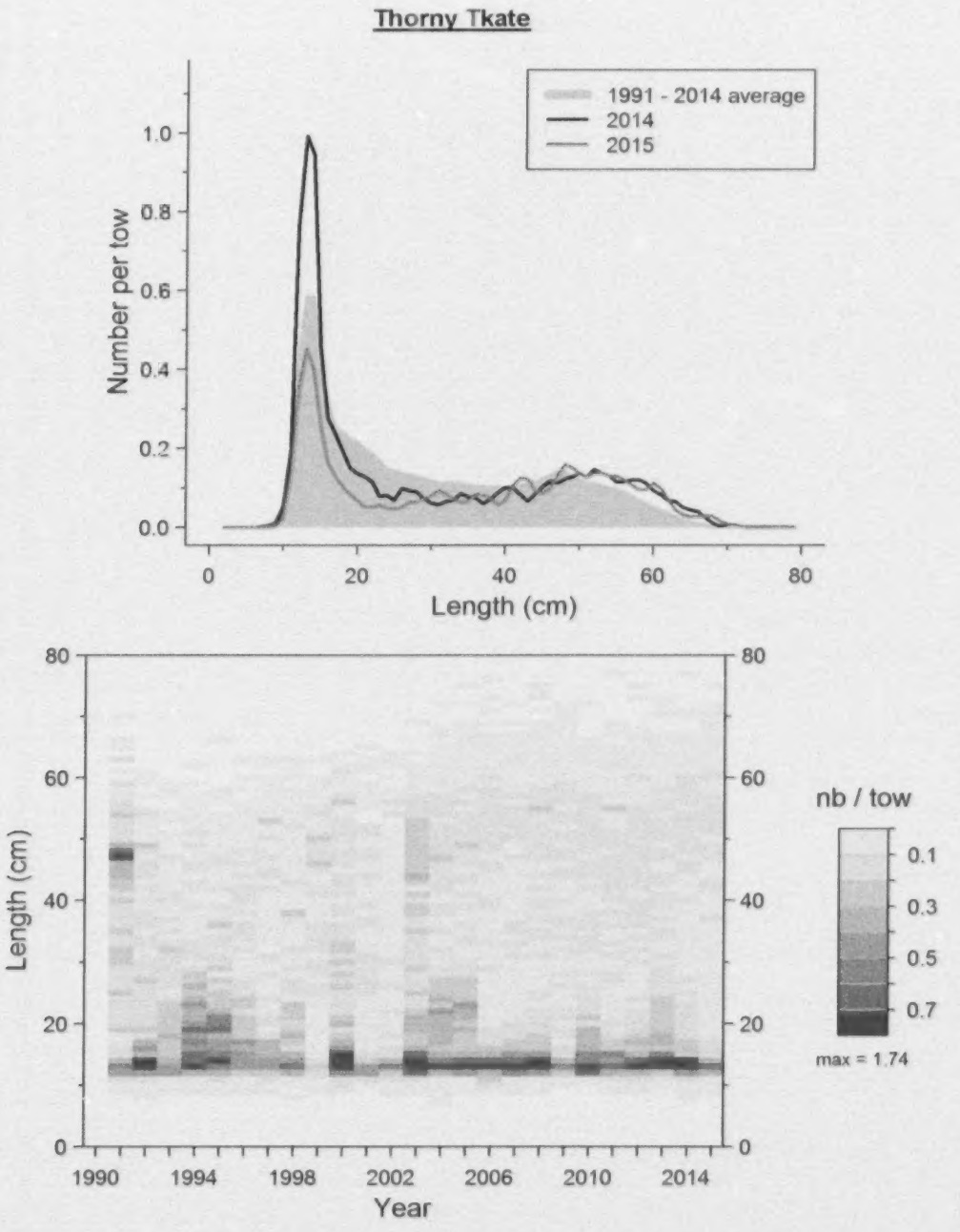


Figure 51. Length frequency distributions (mean number per 15 minutes tow) observed during the survey for Thorny Skate in 4RST.

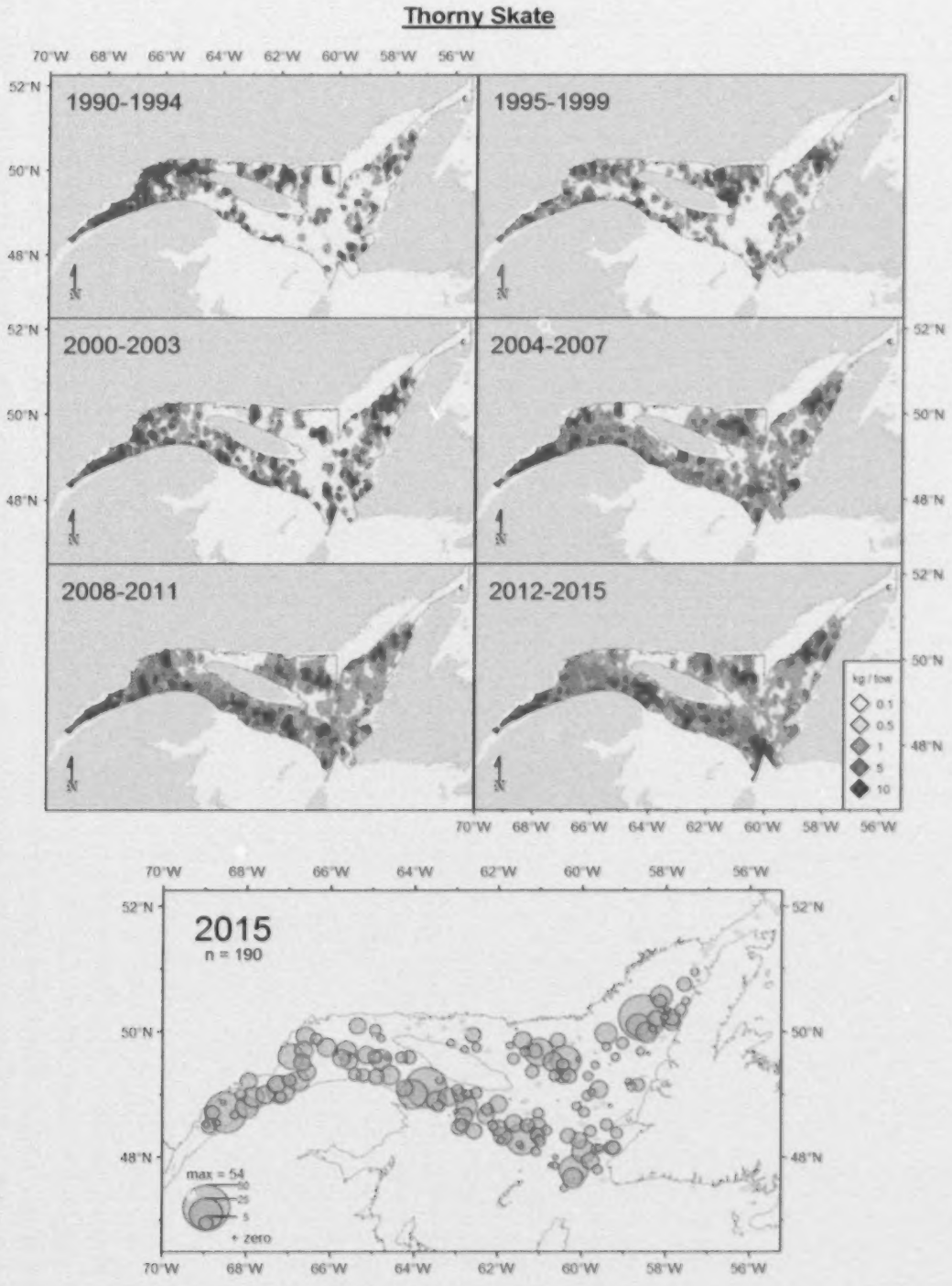


Figure 52. Thorny Skate catch rates (kg/15 minutes tow) distribution.

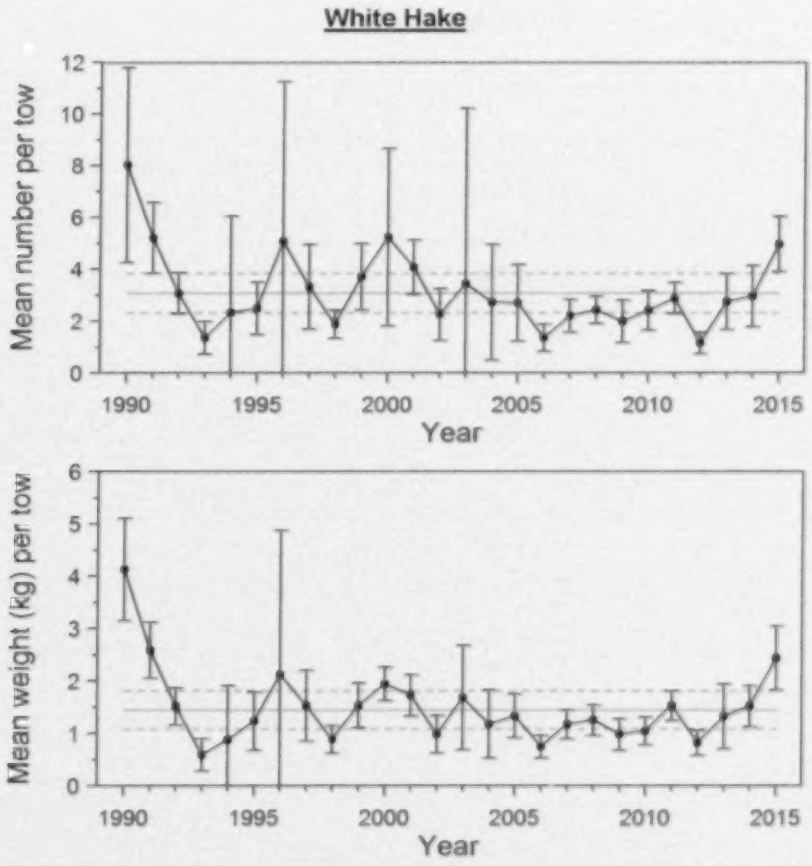


Figure 53. Mean numbers and mean weights per 15 minutes tow observed during the survey for White Hake in 4RST. Error bars indicate the 95% confidence interval and the horizontal lines indicate the mean of the 1990-2014 period (solid line) and upper and lower reference (see text) limits (dashed lines).

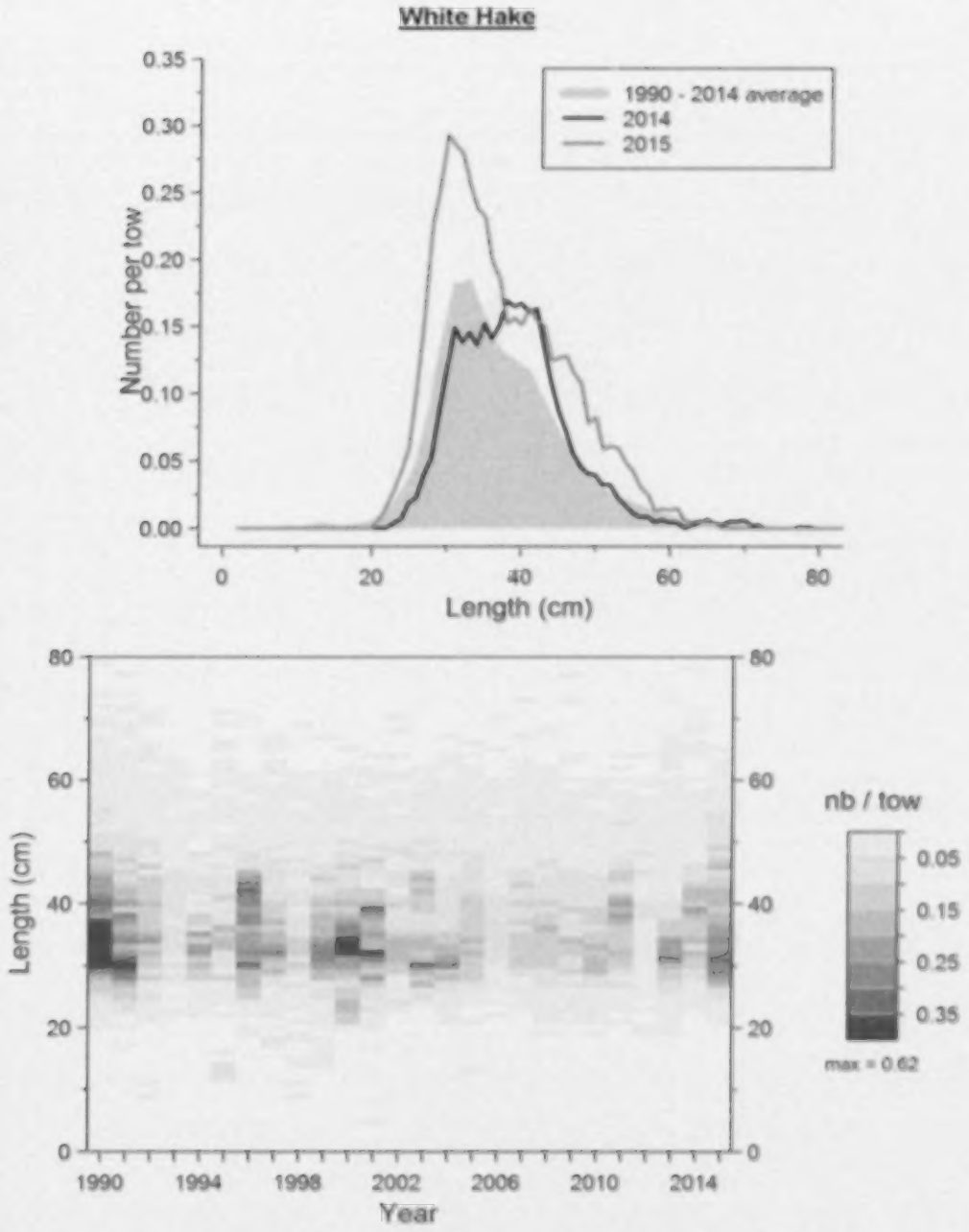


Figure 54. Length frequency distributions (mean number per 15 minutes tow) observed during the survey for White Hake in 4RST.

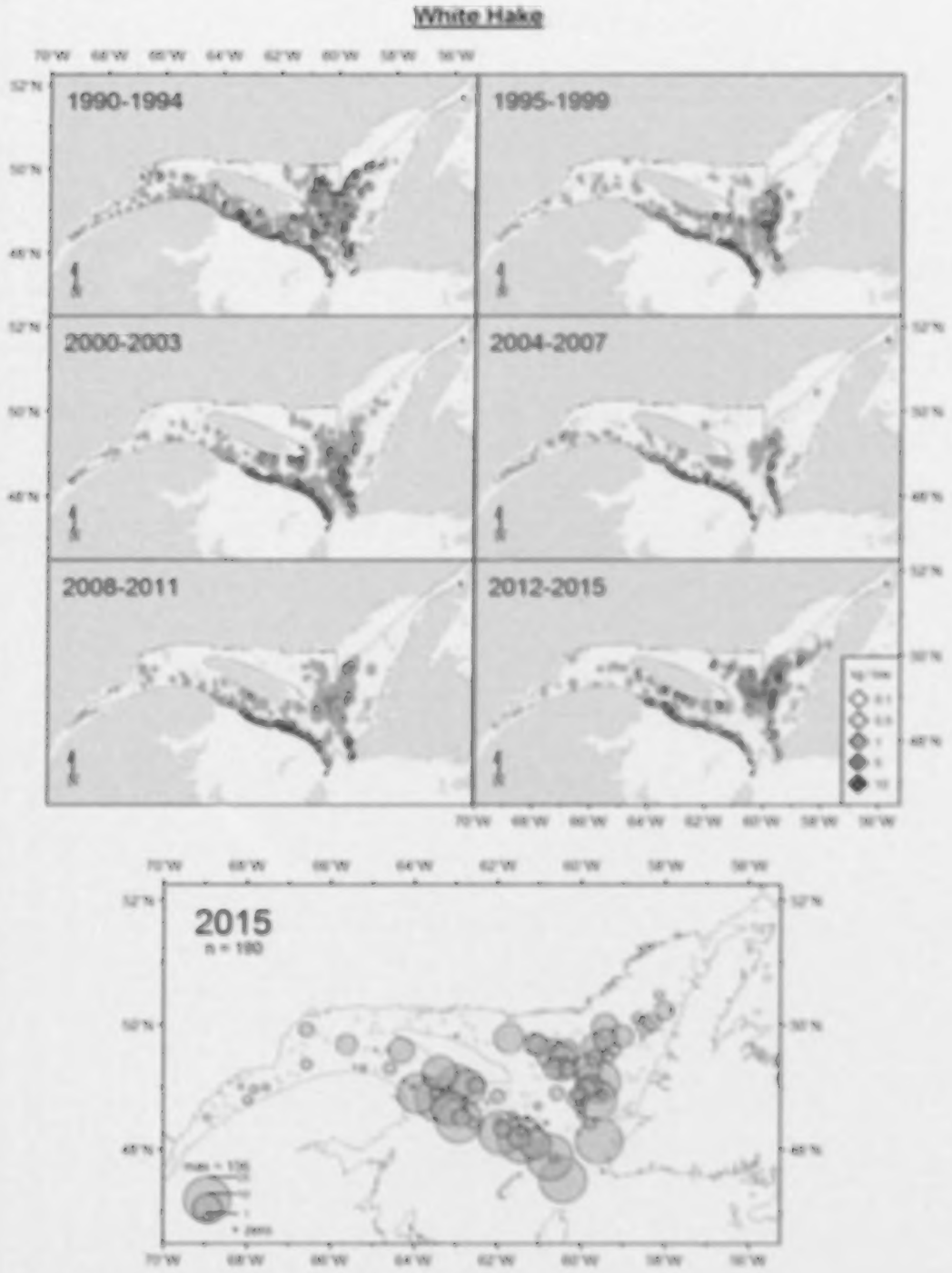


Figure 55. White Hake catch rates (kg/15 minutes tow) distribution.

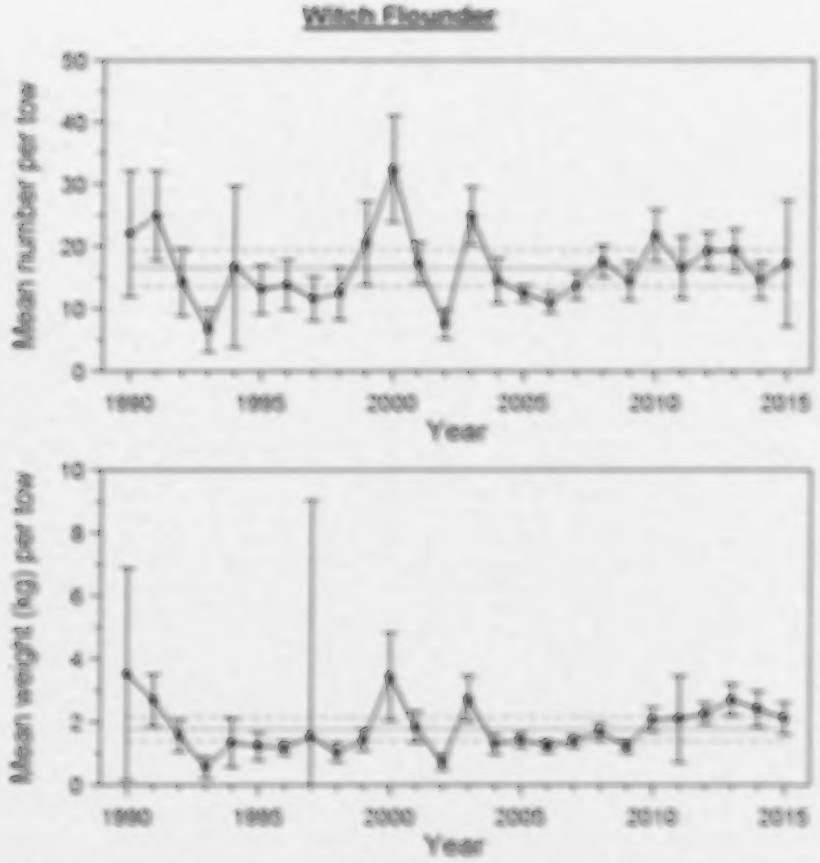


Figure 58. Mean numbers and mean weights per 15 minutes tow observed during the survey for Witch Flounder in 4RST. Error bars indicate the 95% confidence interval and the horizontal lines indicate the mean of the 1990-2014 period (solid line) and upper and lower reference (see text) limits (dashed lines).

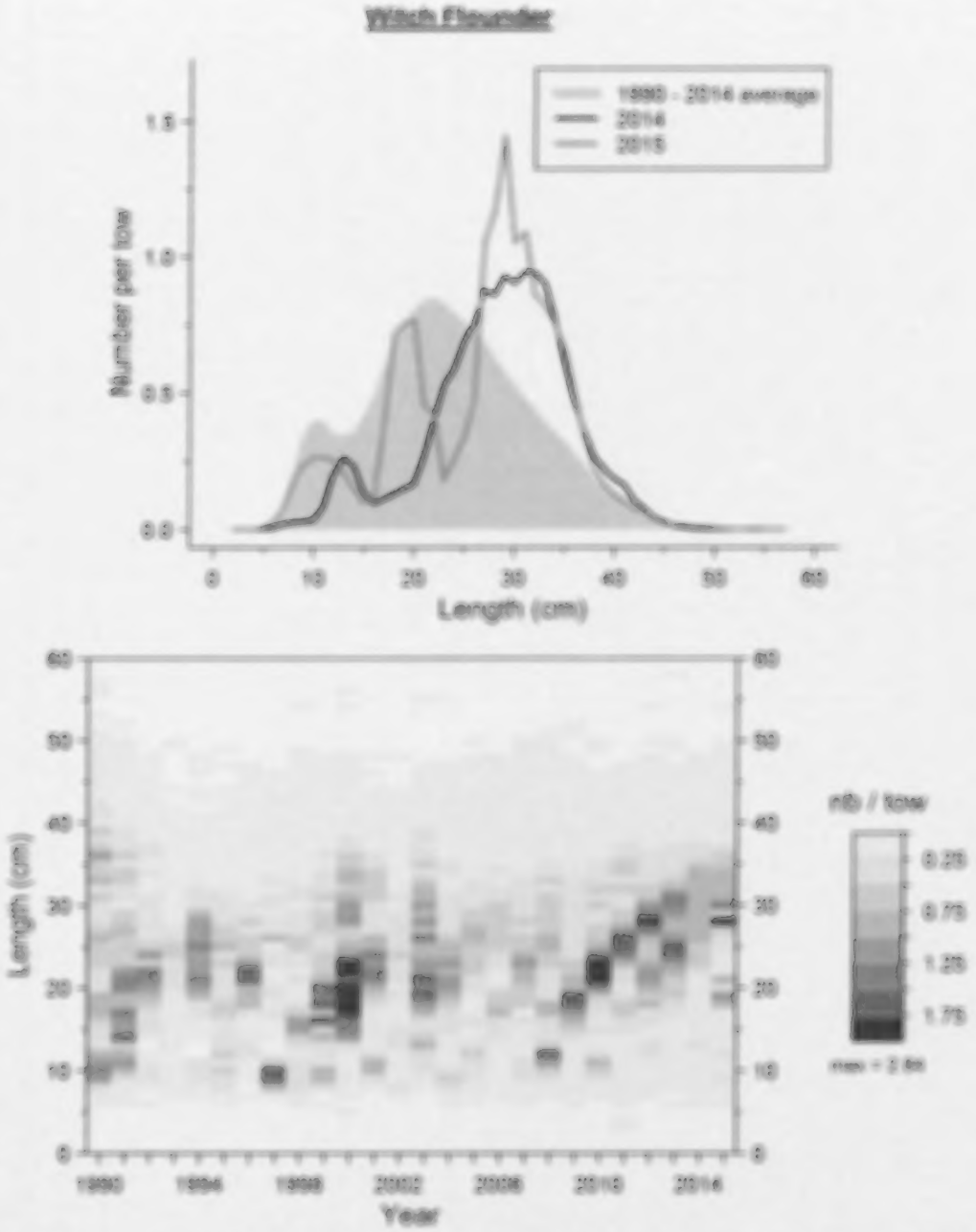


Figure 57. Length frequency distributions (mean number per 15 minutes tow) observed during fall survey for Witch Flounder in 4RST.

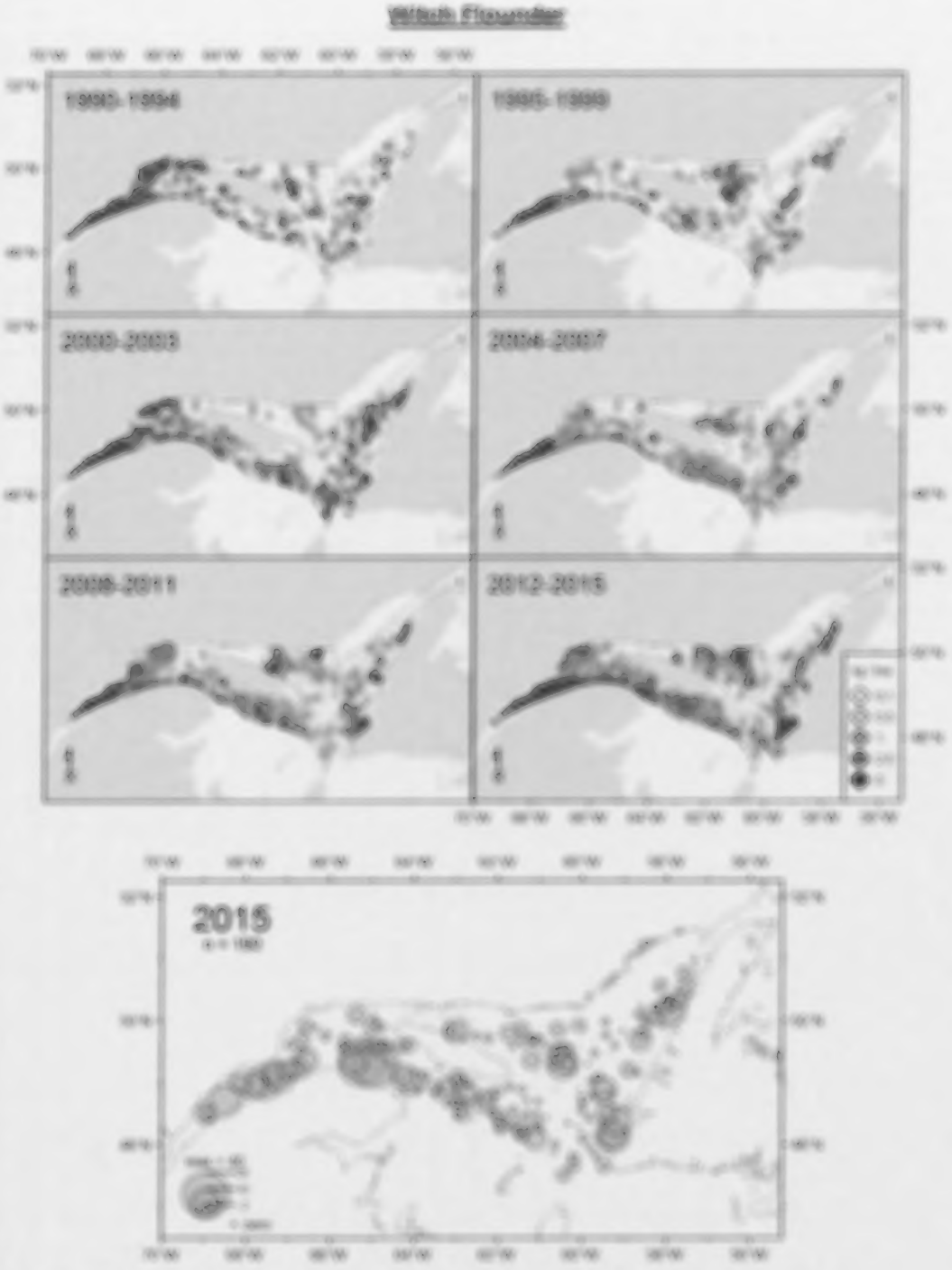


Figure 32. Witch Flounder (witch) ratio (kg/15 minutes tow) distribution.

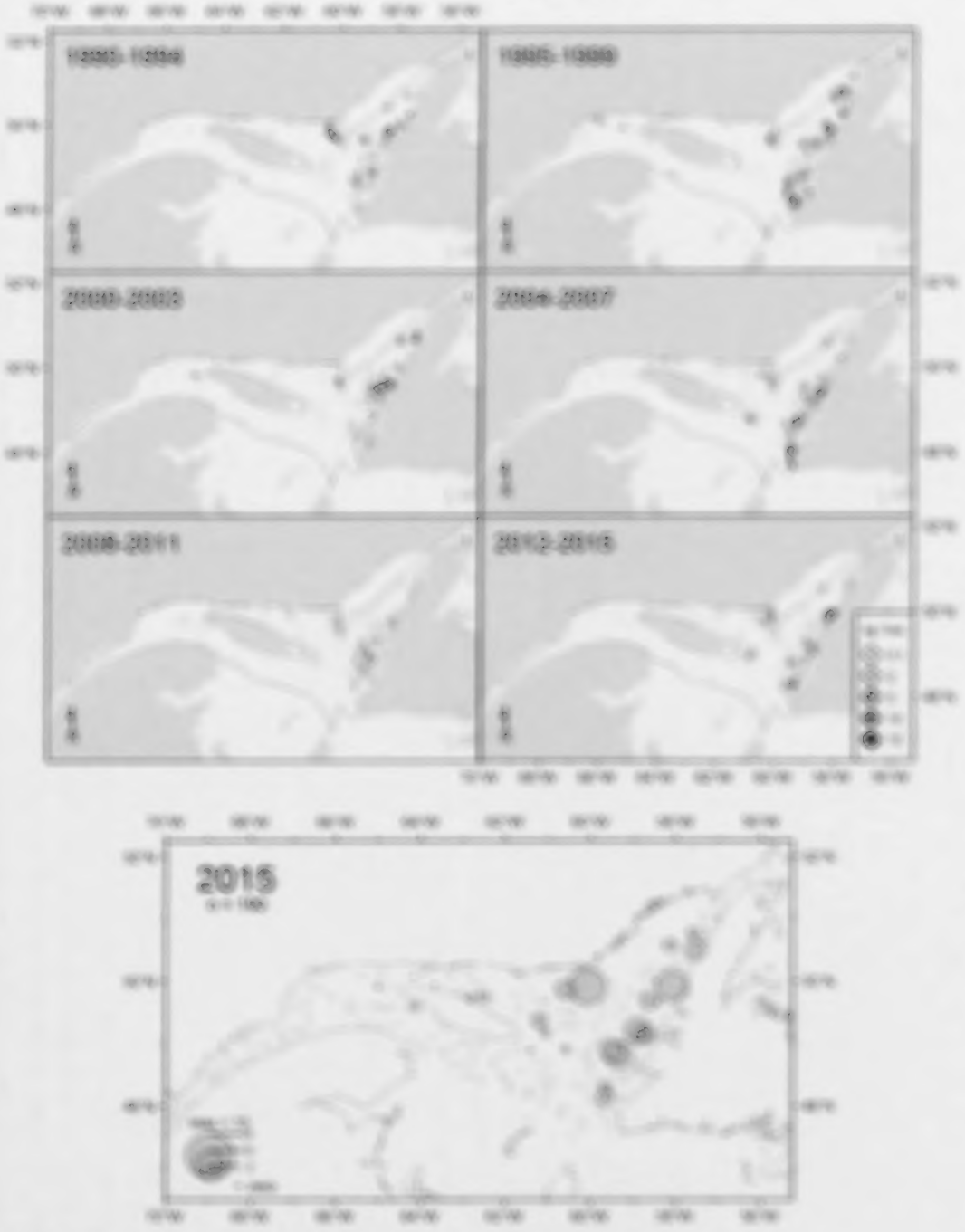


Figure 39. Atlantic Wolffish catch rates (kg/12 minutes tow) distribution.

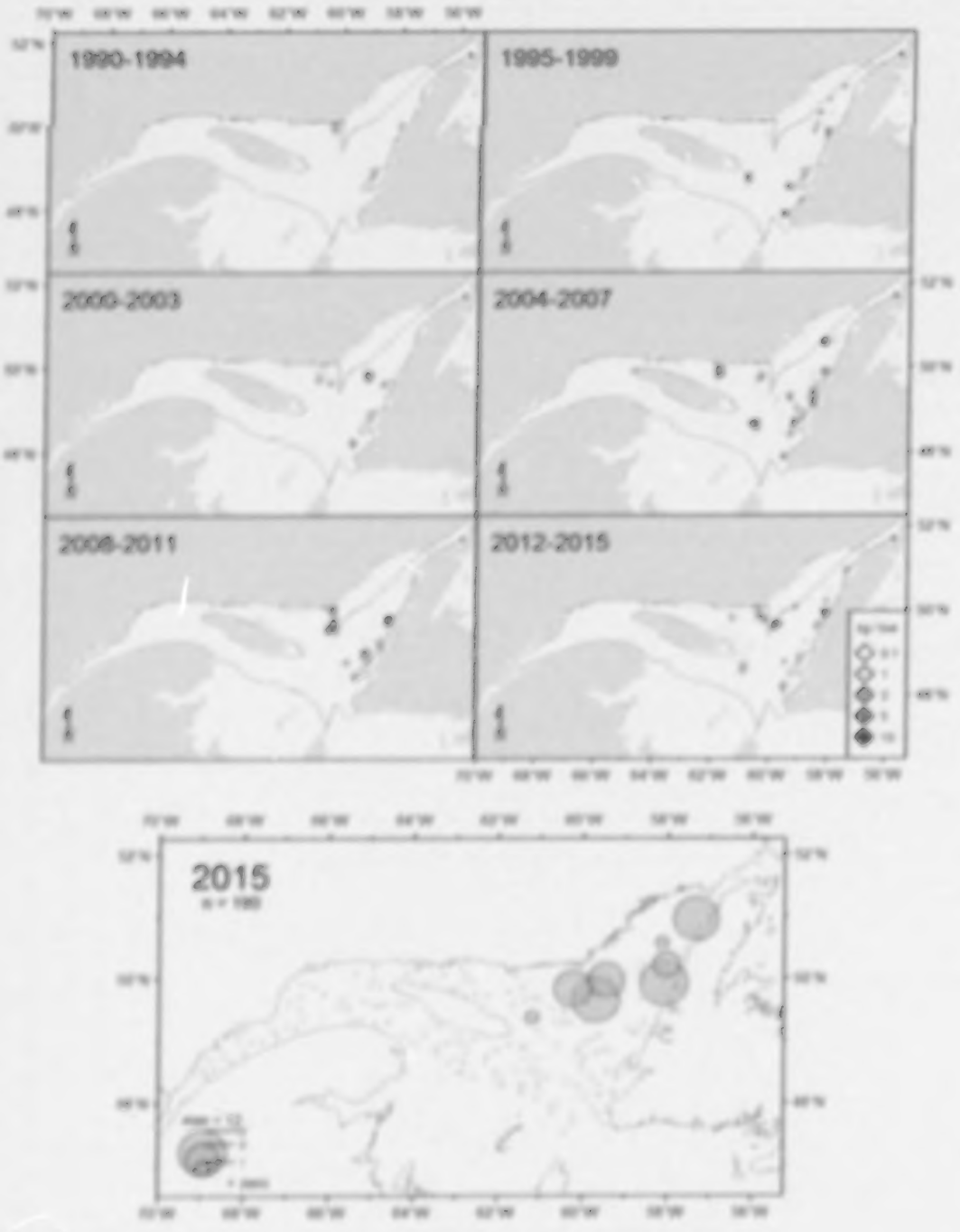


Figure 60. Spotted Wolffish catch rates (kg/15 minutes tow) distribution.

Figure 61. Average weight per 15-minute tow during the fish taxa survey. The colour code represents the anomaly value of the difference between the CPUE in a given year and the average CPUE in the time series divided by the standard deviation of this average for each taxon.

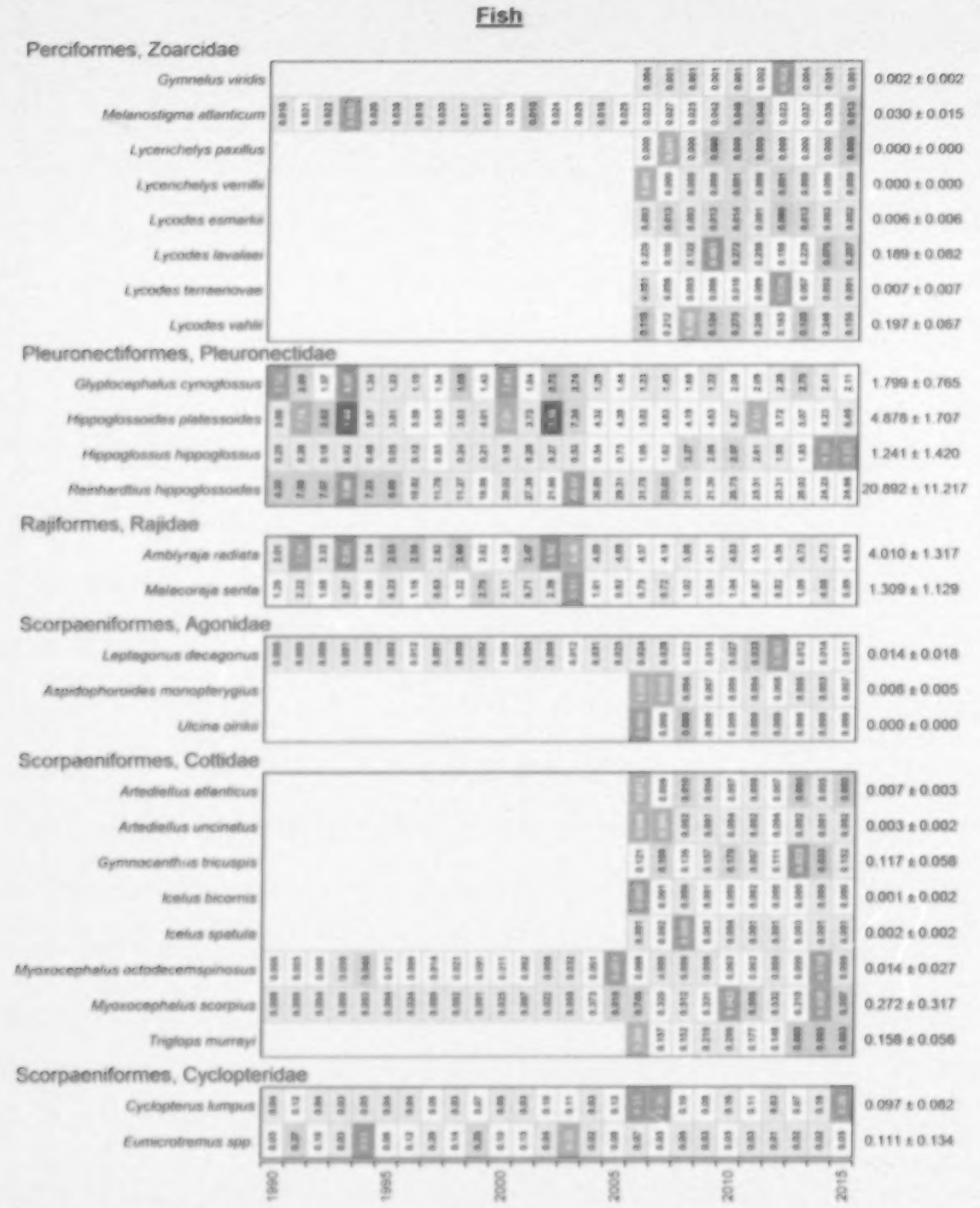


Figure 61. Continued.

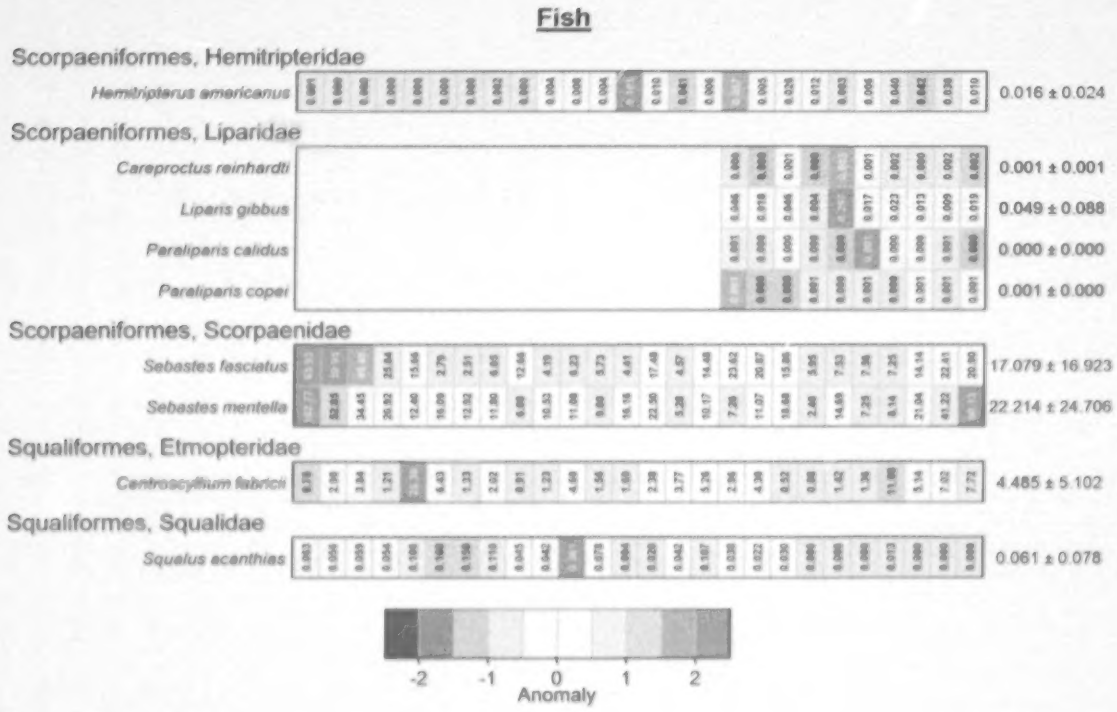


Figure 61. Continued.

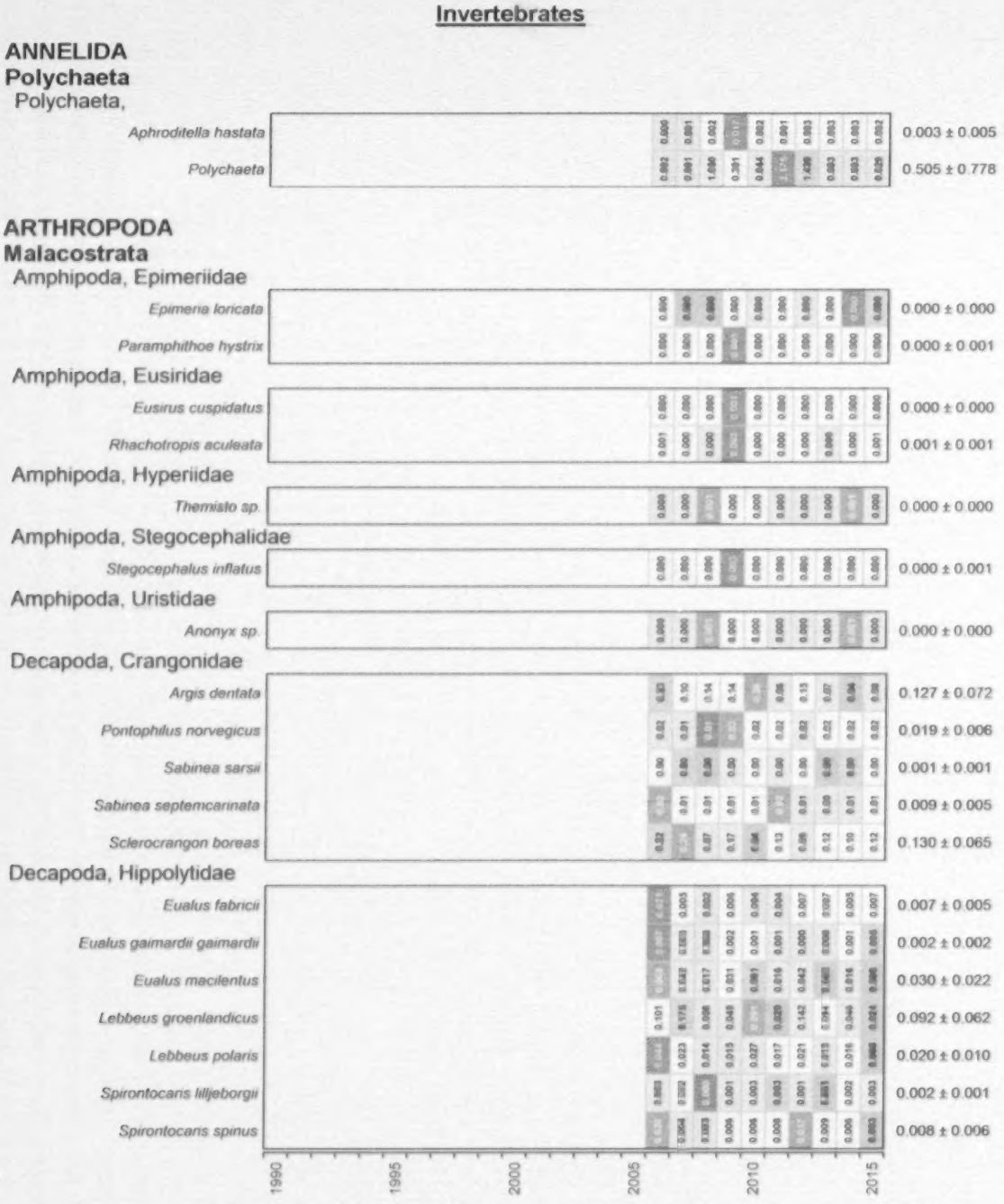


Figure 62. Average weight per 15-minute tow during the invertebrates. The colour code represents the anomaly value of the difference between the CPUE in a given year and the average CPUE in the time series divided by the standard deviation of this average for each taxon.

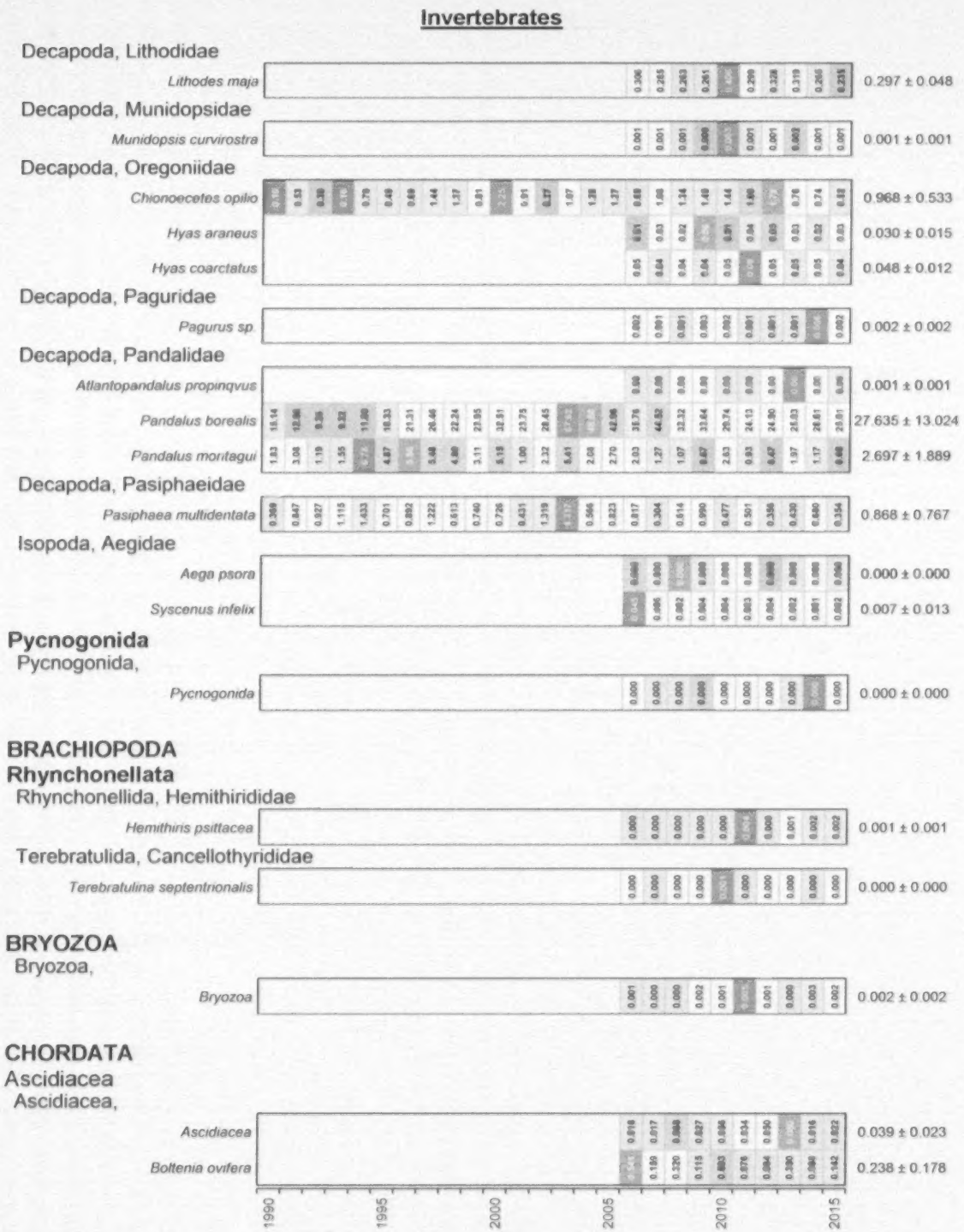


Figure 62. Continued.

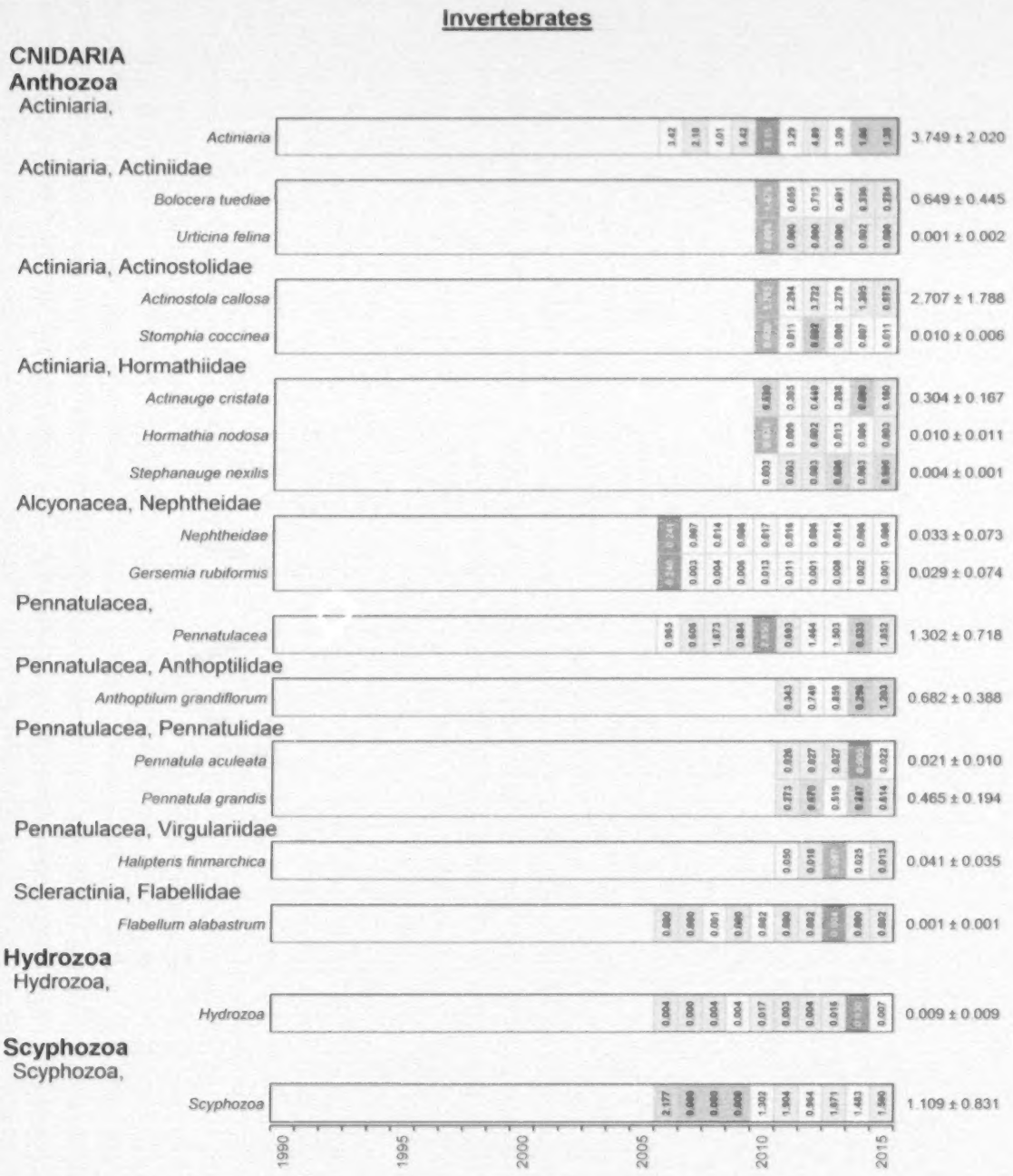


Figure 62. Continued.

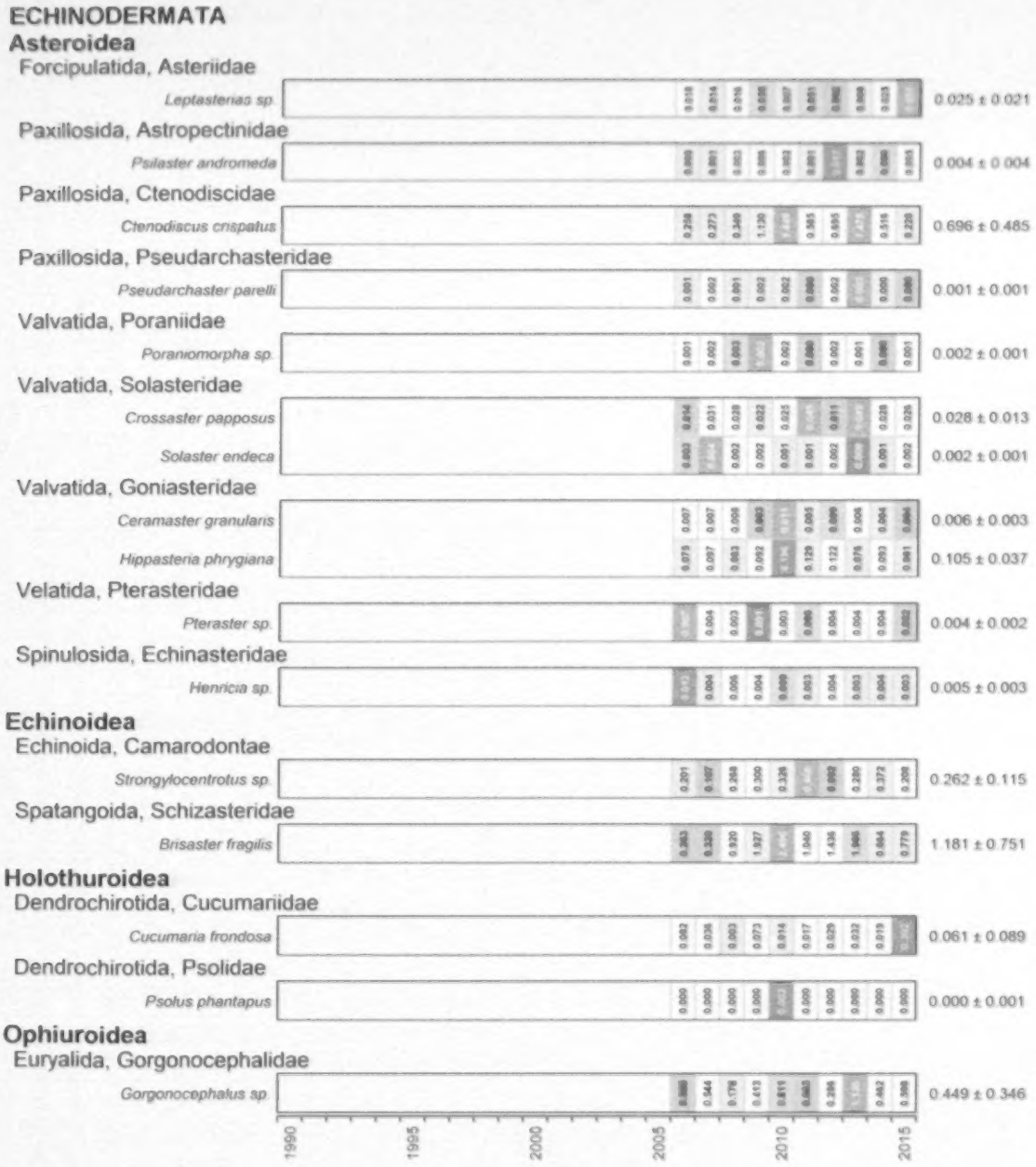


Figure 62. Continued.

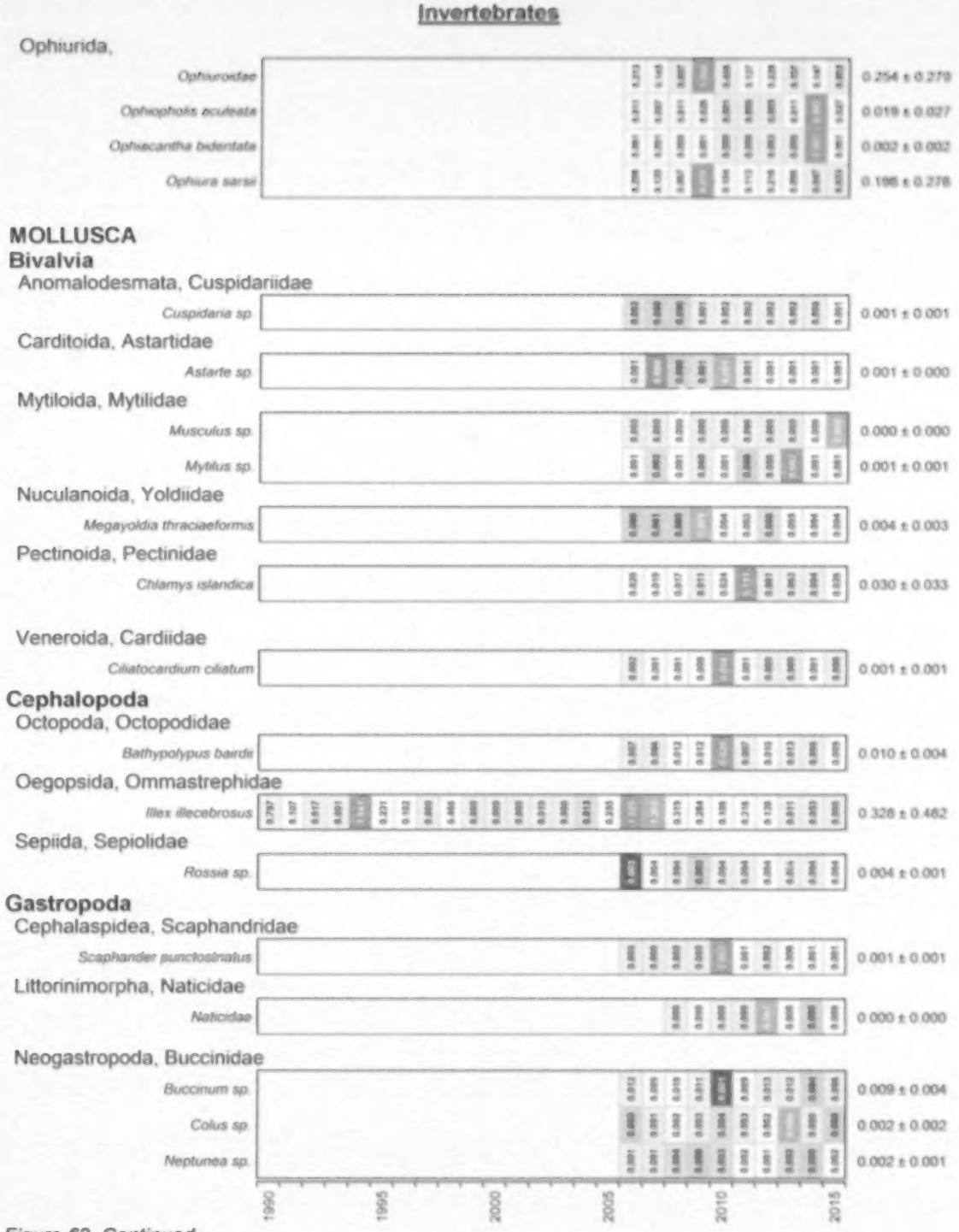


Figure 62. Continued.

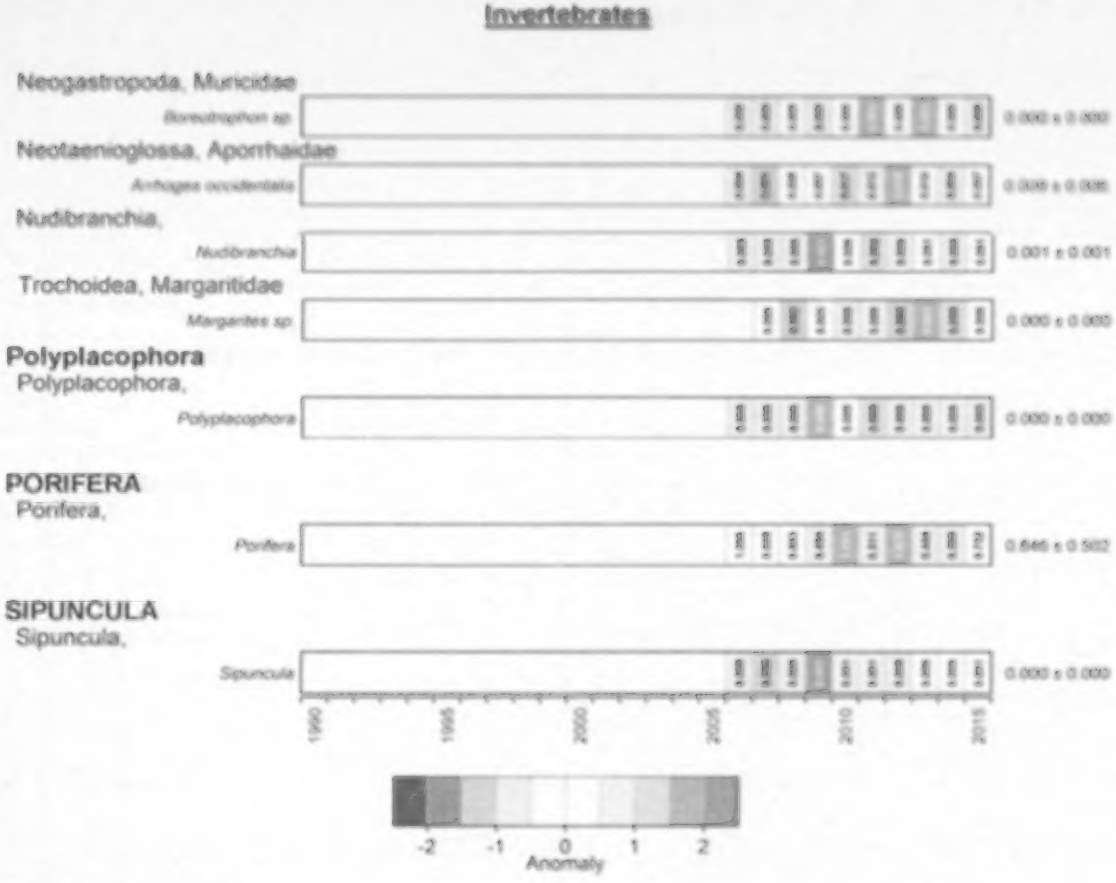


Figure 62. Continued.

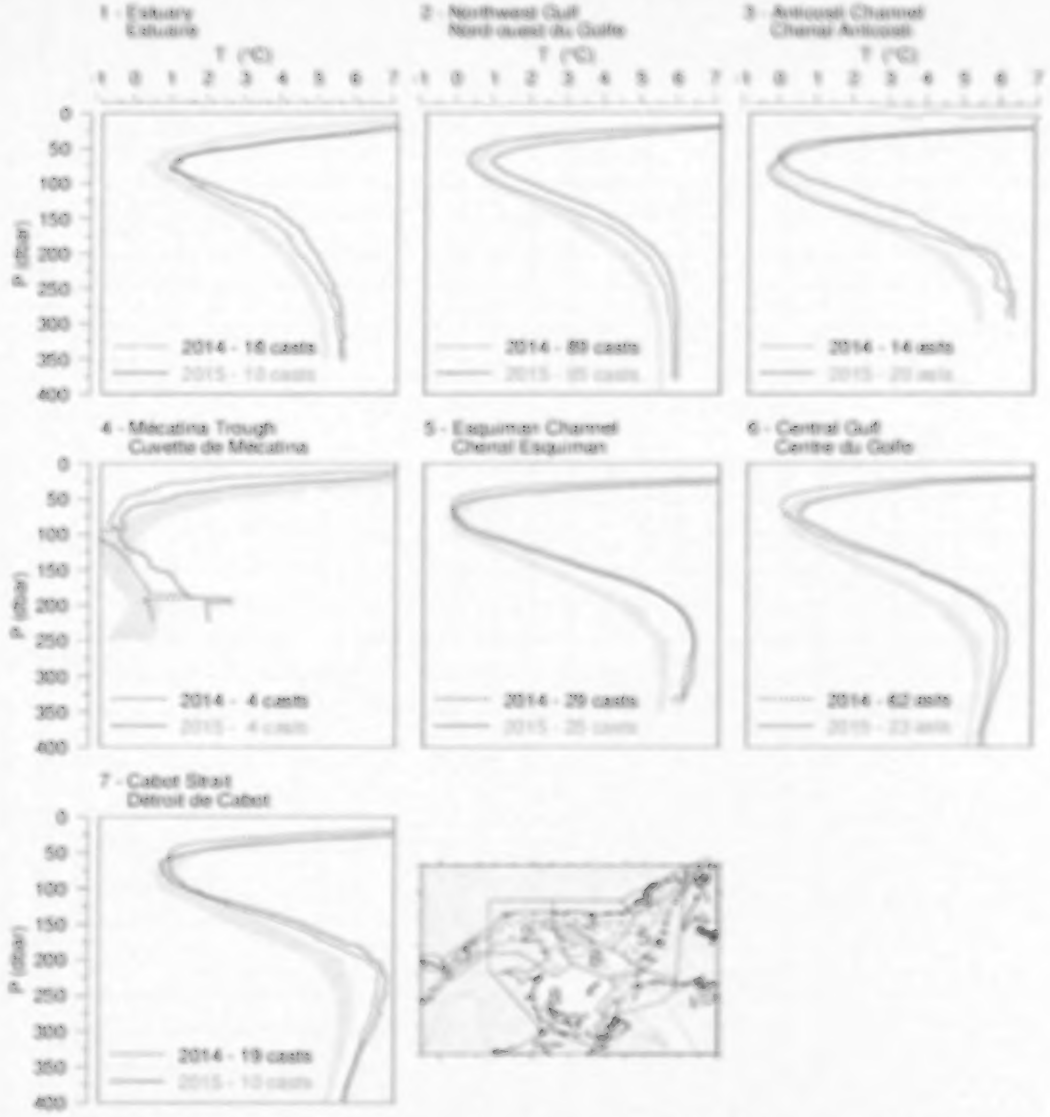
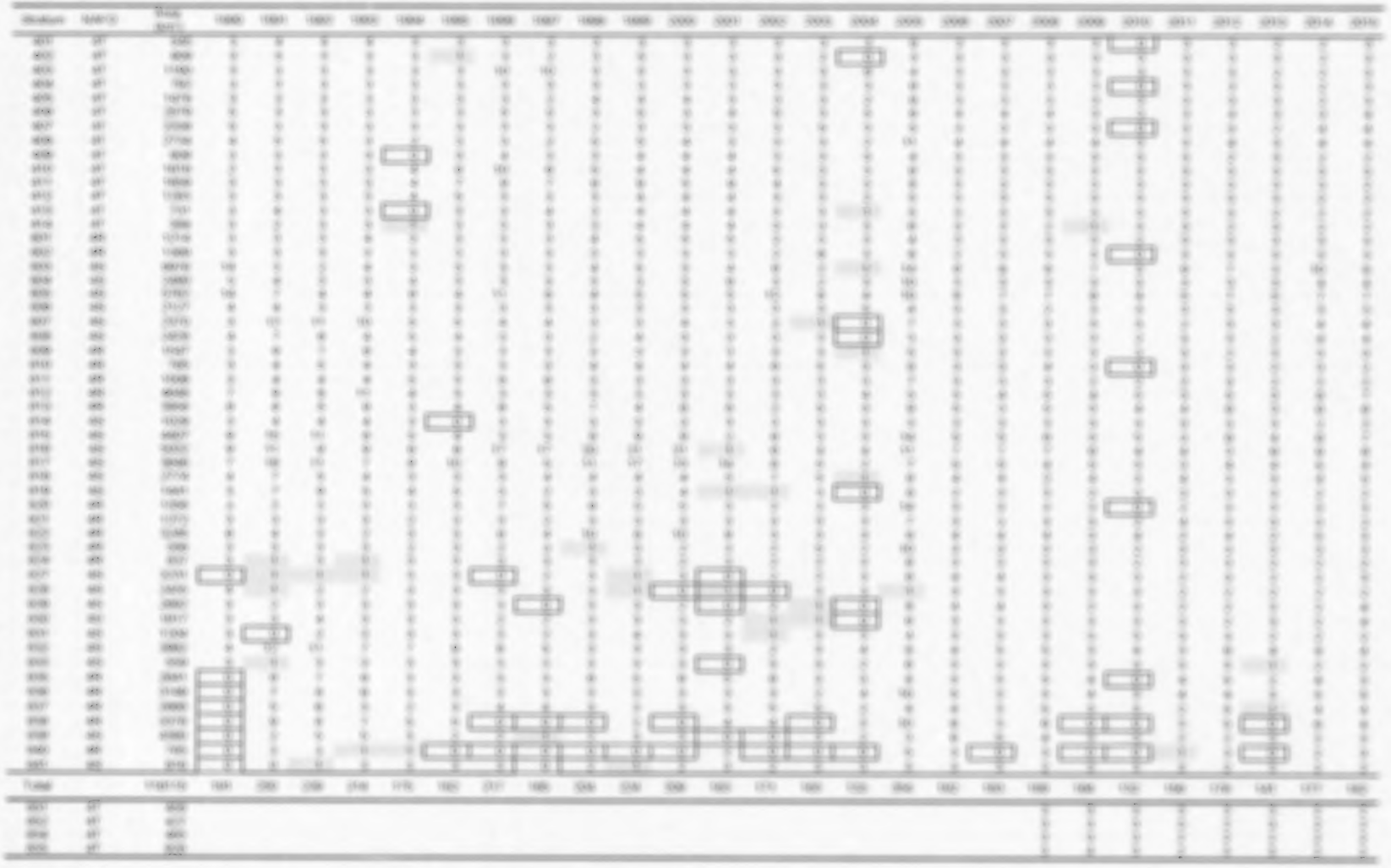


Figure 63. Mean temperature profiles observed in each region of the Gulf during August 215. The shaded area represents the 1981–2010 climatological monthly mean ± 0.5 SD. Mean proles for 2014 are also shown for comparison.

Figure 64. Water temperatures in the Gulf of St. Lawrence. July-August and May to August sea surface temperature averaged over the Estuary and northern Gulf (red lines). Layer-averaged temperature for the Gulf of St. Lawrence at 200 and 300 m (green lines). Cold intermediate layer minimum temperature index (adjusted to July 15) in the Gulf of St. Lawrence, with the 2015 value estimated using data from the August survey (blue line). Climatological averages based on the 1981-2010 period are indicated by thin dashed lines.

APPENDICES

Appendix 1. Number of successful stations per stratum for the DFO survey.



Appendix 2. Occurrences and total catches, in weight and number, by taxon during the 2015 survey (190 successful tows).

STRAP code	Scientific name	French name	English name	Occurrence	Weight (kg)	Number
			Vertebrates			
80	*Amblyraja radiata*	Raie épineuse	Thorny Skate	155	890,4	1319
696	*Ammodytes* sp.	Lançons	Sand Lances	21	0,1	58
700	*Anarhichas lupus*	Loup atlantique	Atlantic Wolffish	29	69,3	181
701	*Anarhichas minor*	Loup tacheté	Spotted Wolffish	8	46,1	10
718	*Ansuarchus medius*	Lompénie-naine	Stout Eelblenny	1	< 0,1	2
320	*Arctozenus risso*	Lussion-blanc	White Barracudina	122	35,6	1872
193	*Argentina silus*	Grande argentine	Atlantic Argentine	8	2	23
811	*Artediellus atlanticus*	Hameçon atlantique	Atlantic Hookear Sculpin	38	0,7	213
812	*Artediellus uncinatus*	Hameçon neigeux	Arctic Hookear Sculpin	14	0,4	127
838	*Aspidophoroides monopterygius*	Poisson-alligator atlantique	Alligatorfish	44	1,9	542
102	*Bathyraja spinicauda*	Raie à queue épineuse	Spinytail Skate	4	16,3	3
451	*Boreogadus saida*	Saida franc	Arctic Cod	24	2,8	168
865	*Careproctus reinhardti*	Petite limace-de-mer	Sea Tadpole	8	0,4	19
27	*Centroscyllium fabricii*	Aiguillat noir	Black Dogfish	23	1358,1	2739
150	*Clupea harengus*	Hareng atlantique	Atlantic Herring	111	522,3	3182
829	*Cottunculus microps*	Cotte polaire	Polar Sculpin	1	< 0,1	1
721	*Crypdacanthodes maculatus*	Terrassier tacheté	Wrymouth	9	6,6	9
849	*Cyclopterus lumpus*	Grosse poule-de-mer	Lumpfish	39	40,9	85
208	*Cyclothone microdon*	Cyclothone à petites dents	Small-Toothed Bristlemouth	4	< 0,1	5
461	*Enchelyopus cimbrius*	Motelle à quatre barbillons	Fourbeard Rockling	132	78,7	2211
711	*Eumesogrammus praecisus*	Quatre-lignes atlantique	Fourline Snakeblenny	22	7,1	363
844	*Eumicrotremus spinosus*	Petite poule-de-mer atlantique	Atlantic Spiny Lumpsucker	30	6,7	524
845	*Eumicrotremus spinosus variabilis*	Petite poule-de-mer atlantique	Atlantic Spiny Lumpsucker	3	0,1	4
438	*Gadus morhua*	Morue franche	Atlantic Cod	144	4794,8	11561
439	*Gadus ogac*	Ogac, morue-ogac	Greenland Cod	2	1,1	2
453	*Gaidropsarus* sp.	Mustèles	Threebeard Rocklings	1	< 0,1	1
420	*Gasterosteus aculeatus*	Épinoche à trois épines	Threespine Stickleback	7	< 0,1	14
890	*Glyptocephalus cynoglossus*	Plie grise	Witch Flounder	152	408,1	3135
205	Gonostomatidae	Cyclothones	Bristlemouths	1	< 0,1	1
748	*Gymnelus viridis*	Unemak camétéon	Fish Doctor	7	0,2	23
823	*Gymnocanthus tricuspis*	Tricorne arctique	Arctic Staghorn Sculpin	30	27,8	516
797	*Hadrolenus dactylopterus*	Chèvre impériale	Blackbelly Rosefish	2	0,2	3
809	*Hemitripterus americanus*	Hémitriptère atlantique	Sea Sculpin	3	1,6	3
889	*Hippoglossoides platessoides*	Plie canadienne	American Plaice	155	1080,5	14878

STRAP* code	Scientific name	French name	English name	Occurrence	Weight (kg)	Number
893	*Hippoglossus hippoglossus*	Flétan atlantique	Atlantic Halibut	65	895,6	145
831	*Icelus bicornis*	Icèle à deux cornes	Twohorn Sculpin	3	< 0,1	7
832	*Icelus spatula*	Icèle spatulée	Spatulate Sculpin	14	0,3	60
285	*Lampadena speculigera*	Lanterne-miroir	Mirror Lanternfish	1	< 0,1	
836	*Leptagonus decagonus*	Agone atlantique	Atlantic Poacher	26	2,5	146
717	*Leptoclinus maculatus*	Lompénie tachetée	Daubed Shanny	61	7,8	1351
891	*Limanda ferruginea*	Limande à queue jaune	Yellowtail Flounder	3	0,5	3
862	*Liparis gibbus*	Limace marbrée	Variegated Snailfish	12	1,8	28
966	*Lophius americanus*	Baudroie d'Amérique	Monkfish, Goosefish	9	47,6	11
716	*Lumpenus lampretaeformis*	Lompénie-serpent	Snakeblenny	35	9,1	410
750	*Lycenchelys paxillus*	Lycode commune	Common Wolf Eel	1	< 0,1	1
752	*Lycenchelys verrillii*	Lycode à tête longue	Wolf Eelpout	11	< 0,1	12
727	*Lycodes esmarkii*	Lycode d'Esmark	Esmark's Eelpout	2	0,3	2
728	*Lycodes lavalaei*	Lycode du Labrador	Newfoundland Eelpout	24	36,2	109
733	*Lycodes polaris*	Lycode polaire	Canadian Eelpout	1	0,1	3
726	*Lycodes* sp.	Lycodes	Eelpouts	7	1,7	13
734	*Lycodes terraenovae*	Lycode atlantique	Atlantic Eelpout	3	0,3	6
730	*Lycodes vahlii*	Lycode à carreaux	Vahl's Eelpout	34	39,3	587
91	*Malacoraja senta*	Raie lisse	Smooth Skate	124	169,1	995
187	*Mallotus villosus*	Capelan	Capelin	79	540,8	40905
441	*Melanogrammus aeglefinus*	Aiglefin	Haddock	4	3,8	10
745	*Melanostigma atlanticum*	Molasse atlantique	Atlantic Soft Pout	54	2,7	741
449	*Merluccius bilinearis*	Merlu argenté	Silver Hake	51	38,1	144
272	Myctophidae	Poissons-lanterne	Lanternfishes	32	4,5	255
271	Myctophiformes	Poissons des profondeurs	Deepwater Fishes	1	< 0,1	1
819	*Myoxocephalus scorpius*	Chaboisseau à épines courtes	Shorthorn Sculpin	35	81,3	209
12	*Myxine glutinosa*	Myxine du nord	Northern Hagfish	110	151,6	2845
368	*Nemichthys scolopaceus*	Avocette ruban	Atlantic Snipe Eel	2	0,1	2
278	*Neoscopelus macrolepidotus*	Lanterne à grandes écailles	Glowingfish	4	0,1	6
478	*Nezumia bairdii*	Grenadier du grand Banc	Common Grenadier	98	58,6	1661
275	*Notoscopelus elongatus*	Lanterne-voilière nordique	Kroyer's Lanternfish	2	0,2	7
874	*Paraliparis calidus*	Limace ardente	Lowfin Snailfish	4	< 0,1	5
856	*Paraliparis copei*	Limace à museau noir	Blacksnout Seasnail	7	0,1	14
15	*Petromyzon marinus*	Lamproie marine	Sea Lamprey	1	< 0,1	1
444	*Phycis chesteri*	Merluche à longues nageoires	Longfin Hake	41	68	549
443	*Pollachius virens*	Goberge	Pollock	1	2,5	3
222	*Polyipnus clarus*	Hache	Slope Hachetfish	1	< 0,1	1
94	*Rajella fyllae*	Raie ronde	Round Skate	1	0,5	1

STRAP* code	Scientific name	French name	English name	Occurrence	Weight (kg)	Number
892	*Reinhardtius hippoglossoides*	Flétan du Groenland, turbot	Greeenland Halibut, Turbot	153	4583,6	22984
572	*Scomber scombrus*	Maquereau bleu	Atlantic Mackerel	46	3,6	609
398	*Scomberesox saurus*	Balaou	Atlantic Saury	1	0,1	1
796	*Sebastes fasciatus*	Sébaste acadien	Acadian Redfish	143	4237,4	63764
794	*Sebastes mentella*	Sébaste atlantique	Deepwater Redfish	153	18554,8	346007
793	*Sebastes norvegicus*	Sébaste orangé	Golden Redfish	1	5,8	2
710	*Stichaeus punctatus*	Stichée arctique	Arctic Shanny	1	< 0,1	1
814	*Triglops murrayi*	Faux-trigle armé	Moustache Sculpin	42	12,8	2122
837	*Ulcina olrikii*	Poisson-alligator arctique	Arctic Alligatorfish	4	0,1	26
447	*Urophycis tenuis*	Merluche blanche	White Hake	89	699,8	1372
168	*Xenodermichthys copei*	Gymnaste atlantique	Bluntsnout Smoothhead	2	0,1	2
	Total	**Vertébrés**	**Vertebrates**		39 664	531 936
			Invertebrates			
1100		Invertébrés	Invertebrates	5	< 0,1	5
8040	*Acanthephyra pelagica*	Crevette	Shrimp	2	0,1	5
8039	*Acanthephyra* sp.	Crevette	Shrimp	1	< 0,1	2
2182	*Actinauge cristata*	Anémone de mer	Anemone	52	26,5	1847
2165	Actiniaria	Actinies et Anémones	Sea Anemones	3	< 0,1	7
2162	*Actinostola callosa*	Anémones de mer	Anemone	58	203,9	1754
6771	*Aega psora*	Isopode	Isopod	8	< 0,1	8
2677	*Alcyonidium pachydermatum*	Bryozoaire	Bryozoan	3	0,4	47
2675	*Alcyonidium* sp.	Bryozoaire	Bryozoan	2	< 0,1	5
6996	*Ampelisca* sp.	Gammaride	Amphipod	1	< 0,1	1
8593	*Amphiura* sp.	Ophiures	Brittle Star	13	0,1	61
4219	*Anomia* sp.	Anomies	Jingle Shells	2	< 0,1	8
7389	*Anonyx* sp.	Gammarides	Gammarids	11	< 0,1	47
2218	*Anthoptilum grandiflorum*	Plume de mer	Sea Pen	43	46,8	3037
5002	*Aphroditella hastata*	Souris de mer	Sea Mouse	13	0,4	16
6594	*Arcoscalpellum michelottianum*	Balane	Barnacle	3	0,1	7
8138	*Argis dentata*	Crevette verte	Arctic Argid	38	15	3767
3418	*Arrhoges occidentalis*	Pied-de-pélican	American Pelicanfoot	17	0,8	79
8742	*Ascidia* sp.	Ascidie	Sea Squirts	1	0,1	1
8680	Ascidiacea	Ascidies, tuniqués sessiles	Ascidians, Sessile Tunicates	78	3	827
4227	*Astarte* sp.	Astartes	Astartes	25	0,2	160
8113	*Atlantopandalus propinqvus*	Crevette	Shrimp	12	0,6	135
2097	*Atolla wyvillei*	Méduse	Jellyfish	11	0,9	20

STRAP code	Scientific name	French name	English name	Occurrence	Weight (kg)	Number
2085	*Aurelia aurita*	Méduse de lune	Moon Jelly	83	81,3	976
6595	Balanidae	Balanes	Barnacles	8	< 0,1	48
4904	*Bathypolypus bairdii*	Poulpe	North Atlantic Octopus	38	1,9	62
3519	*Beringius turtoni*	Buccin	Whelk	1	0,1	1
3995	Bivalvia	Bivalves	Bivalves	3	< 0,1	4
2158	*Bolocera tuediae*	Anémone de mer	Anemone	71	40,2	528
8793	*Boltenia echinata*	Cactus de mer	Cactus Sea Squirt	5	< 0,1	15
8792	*Boltenia ovifera*	Patate de mer	Sea Potato	19	14,6	150
3488	*Boreotrophon* sp.	Murex	Murex	2	< 0,1	2
8798	*Botrylloides* sp.	Ascidie	Tunicate	2	< 0,1	7
5755	*Brada inhabilis*	Polychète	Flabelligerid Worm	4	< 0,1	5
8378	*Brisaster fragilis*	Oursin coeur	Heart Urchin	79	143,6	22983
2670	Bryozoa	Bryozoaires	Bryozoans	20	0,3	225
3523	*Buccinum scalariforme*	Buccin	Ladder Whelk	2	0,1	3
3516	*Buccinum* sp.	Buccins	Whelk	29	0,8	58
3517	*Buccinum undatum*	Buccin commun	Waved Whelk	3	0,1	6
8173	*Calocaris templemani*	Crevette fouisseuse	Lobster Shrimp	3	< 0,1	3
8429	*Ceramaster granularis*	Étoile de mer	Sea Star	16	0,6	28
8213	*Chionoecetes opilio*	Crabe des neiges	Snow Crab	99	159,6	1117
6593	*Chirona hameri*	Balane turbané	Turban Barnacle	3	0,2	24
4167	*Chlamys islandica*	Pétoncle d'Islande	Iceland Scallop	17	2,3	123
4351	*Ciliatocardium ciliatum ciliatum*	Coque d'Islande	Iceland Cockle	6	0,3	10
8757	*Cnemidocarpa finmarkiensis*	Ascidie	Tunicate	1	< 0,1	1
1340	Cnidaria	Cnidaires	Cnidarians	4	< 0,1	4
3908	*Colga villosa*	Nudibranche	Nudibranch	13	< 0,1	22
3577	*Colus pubescens*	Buccin	Hairy Whelk	3	< 0,1	4
4124	*Crenella faba*	Crénella fauve	Bean Crenella	1	< 0,1	2
8447	*Crossaster papposus*	Soleil de mer épineux	Spiny Sun Star	31	3,8	180
3422	*Cryptonatica affinis*	Lunaties	Arctic moonsnail	3	< 0,1	3
8407	*Ctenodiscus crispatus*	Étoile de mer	Mud Star	108	48,3	12998
8312	*Cucumaria frondosa*	Concombre de mer	Orange Footed Sea Cucumber	6	34,8	74
4526	*Cuspidaria glacialis*	Mye	Gacial Dipperclam	1	< 0,1	2
4525	*Cuspidaria* sp.	Myes	Dipperclams	36	0,2	144
2080	*Cyanea capillata*	Crinière de lion	Lion's Mane	99	51,9	267
4268	*Cyclocardia borealis*	Vénéricarde boréale	Northern Cyclocardia	3	< 0,1	5
3893	*Dendronotus* sp.	Nudibranche	Nudibranch	11	0,1	18
3976	Dentaliidae	Scaphopodes	Tuskshells	1	< 0,1	1
8408	*Diplopteraster multipes*	Étoile de mer	Sea Star	3	0,3	3

STRAP* code	Scientific name	French name	English name	Occurrence	Weight (kg)	Number
3965	*Doridoxa ingolfiana*	Nudibranche	Nudibranch	6	< 0,1	6
2191	*Drifa glomerata*	Corail mou	Soft Coral	29	0,2	87
2183	*Duva florida*	Corail mou	Sea Cauliflower	20	0,8	34
8373	*Echinarachnius parma*	Dollar de sable	Common Sand Dollar	4	0,2	19
7383	*Epimeria loricata*	Gammaride	Gammarid	8	< 0,1	10
2157	*Epizoanthus* sp.	Anémone de mer	Sea Anemone	51	0,2	1084
8075	*Eualus fabricii*	Bouc Arctique	Arctic Eualid	16	1,1	1344
8081	*Eualus gaimardii belcheri*	Bouc	Circumpolar Eualid	2	< 0,1	2
8080	*Eualus gaimardii gaimardii*	Bouc	Circumpolar Eualid	18	0,7	649
8077	*Eualus macilentus*	Bouc du Groenland	Greenland Shrimp	20	1,7	1651
8074	*Eualus* sp.	Bouc	Eualid	6	0,1	
8778	*Eudistoma vitreum*	Ascidie	Tunicate	13	0,1	49
5045	*Eunoe nodosa*	Polychète	Seaworm	1	< 0,1	1
5461	*Euphrosine borealis*	Polychète	Seaworm	2	< 0,1	2
7195	*Eusirus cuspidatus*	Gammaride	Gammarid	7	< 0,1	31
3437	*Euspira pallida*	Lunatie du Groenland	Pale Moonsnail	6	< 0,1	8
2295	Fecampiidae	Vers flats	Flatworms	2	< 0,1	2
2224	*Flabellum alabastrum*	Madrépore	Cup Coral	8	0,3	27
2184	*Gersemia rubiformis*	Corail mou	Sea Strawberry	21	0,1	127
5902	*Golfingia margaritacea*	Sipunculide	Sipunculid	2	< 0,1	5
8540	*Gorgonocephalus* sp.	Gorgonocéphales	Basket Stars	24	51,8	312
2217	*Halipteris finmarchica*	Plume de mer	Sea Pen	19	2,4	149
8797	*Halocynthia pyriformis*	Pêche de mer	Sea Peach	3	0,4	10
5934	*Hamingia arctica*	Échiure	Echiurid	2	< 0,1	2
5046	*Harmothoe* sp.	Polychètes errantes	Fifteen-Scaled Worms	1	< 0,1	3
8263	*Heliometra glacialis*	Lis de mer	Feather Star	1	< 0,1	1
3090	*Hemithiris psittacea*	Brachiopode	Lamp Shell	9	0,3	219
8483	*Henricia* sp.	Étoiles de mer	Sea Stars	53	0,5	201
4437	*Hiatella arctica*	Saxicave arctique	Arctic Saxicave	6	< 0,1	9
8431	*Hippasteria phrygiana*	Étoile de mer	Sea Star	34	14,4	68
2167	*Hormathia nodosa*	Anémone noduleuse	Rugose Anemone	3	0,2	8
8217	*Hyas araneus*	Crabe lyre	Atlantic Lyre Crab	21	4,6	240
8218	*Hyas coarctatus*	Crabe lyre	Arctic Lyre Crab	46	6,5	511
1341	Hydrozoa	Hydrozoaires	Hydrozoans	44	19,9	
8028	*Hymenopenaeus debilis*	Crevette	Shrimp	1	< 0,1	1
6977	*Hyperia galba*	Hypéride	Hyperid	17	< 0,1	43
4753	*Illex illecebrosus*	Encornet rouge nordique	Northern Shortfin Squid	2	0,2	2
5003	*Laetmonice filicornis*	Polychète	Seaworm	9	< 0,1	20

STRAP* code	Scientific name	French name	English name	Occurrence	Weight (kg)	Number
8092	*Lebbeus groenlandicus*	Bouc	Spiny Lebeid	17	4	737
8093	*Lebbeus polaris*	Bouc	Polar Lebeid	47	1,1	812
8091	*Lebbeus* sp.	Boucs	Lebbeids	1	< 0,1	
8511	*Leptasterias polaris*	Étoile de mer polaire	Polar SeaStar	11	7,8	79
8510	*Leptasterias* sp.	Étoiles de mer	Sea Stars	13	0,1	40
8521	*Leptychaster arcticus*	Stelléridé	Sea Star	4	< 0,1	5
2207	*Liponema multicorne*	Anémone	Sea Anerone	9	1,4	24
8196	*Lithodes maja*	Crabe épineux du Nord	Norway Kig Crab	63	48,4	123
3219	*Margarites costalis*	Margarite rosé du Nord	Boreal Roy Margarite	15	0,1	45
3216	*Margarites groenlandicus*	Troque	Greenlan Marguerite	3	< 0,1	5
4025	*Megayoldia thraciaeformis*	Bivalve	Broad Yolia	22	1	195
7268	*Melita dentata*	Gammaride	Gammark	1	< 0,1	1
2171	*Metridium senile*	Anémone de mer	Clonal Plunose Anemone	2	0,2	3
8164	*Munidopsis curvirostra*	Munidopsis curvirostra	Squat Lobter	30	0,2	233
4126	*Musculus* sp.	Moules	Mussels	4	< 0,1	7
4121	*Mytilus* sp.	Moules	Mussels	17	0,2	37
3000	Nemertea	Némerte	Ribbon Wrm	2	< 0,1	4
7483	*Neohela monstrosa*	Gammaride	Gammark	5	< 0,1	10
2219	Nephtheidae	Coraux mous	Soft corair	3	0,1	15
3567	*Neptunea despecta*	Neptunée commune du nord	Ladei Whilk	1	0,1	1
3565	*Neptunea* sp.	Buccins	Whelks	3	0,2	5
4019	*Nuculana* sp.	Bivalves	Nutclams	5	< 0,1	9
5961	*Nymphon* sp.	Araignées de mer	Sea Spidrs	33	< 0,1	105
4673	Onychoteuthidae	Comet	Hooked Suid	1	< 0,1	1
8575	*Ophiacantha bidentata*	Ophiure épineuse	Brittle Sta	36	0,7	1751
8583	*Ophiopholis aculeata*	Ophiure pâquerette	Daisy Brite Star	48	3,6	2486
8585	*Ophioscolex glacialis*	Ophiure	Brittle Sta	11	< 0,1	17
8552	*Ophiura robusta*	Ophiure	Brittle Sta	10	< 0,1	21
8553	*Ophiura sarsii*	Ophiure	Brittle Sta	51	8,8	9807
8530	Ophiuroidea	Ophiures	Brittle Star	2	< 0,1	3
8178	*Pagurus* sp.	Bernards hermites droitiers	Hermits Cabs	13	0,1	41
8111	*Pandalus borealis*	Crevette nordique	Northern hrimp	165	4412,7	781843
8112	*Pandalus montagui*	Crevette ésope	Striped Pik Shrimp	98	393,6	120334
7586	*Paramphithoe hystrix*	Gammaride	Gammark	5	< 0,1	9
8057	*Pasiphaea multidentata*	Sivade rose, Crevette blanche	Pink Glas Shrimp	92	75,7	31008
8781	*Pelonaia corrugata*	Ascidie	Tunicate	1	< 0,1	1
2203	*Pennatula aculeata*	Plume de mer	Sea Pen	89	4,1	2172
2210	*Pennatula grandis*	Plume de mer	Sea Pen	25	195,5	3175

STRAP code	Scientific name	French name	English name	Occurrence	Weight (kg)	Number
20395	*Periphylla periphylla*	Méduse à couronne	Crown Jellyfish	79	171.1	202
59027	*Phascolion strombus strombus*	Sipunculide	Hermit Sipunculid	6	< 0.1	10
22515	*Pleurobrachia pileus*	Groseille de mer ronde	Sea Gooseberry	28	0.2	204
35.76	*Plicifusus kroyeri*	Colus	Arctic Whelk	2	< 0.1	4
87853	*Polycarpa fibrosa*	Ascidie	Tunicate	2	< 0.1	7
40950	Polychaeta	Polychètes	Polychaetes	1146	21.4	17417
11039	*Polymastia* sp.	Éponge	Sponge	9	0.1	20
92607	Polynoidae	Polychète errante	Fifteen-Scaled Worm	11	< 0.1	31
52954	*Polyphysia crassa*	Polychète	Sea Worm	2	< 0.1	3
31225	Polyplacophora	Chitons	Chitons	1	< 0.1	3
81305	*Pontophilus norvegicus*	Crevette	Norwegian Shrimp	73	3.8	22807
84305	*Porania*morpha sp.	Étoile de mer	Sea Star	4	0.2	4
11031	Porifera	Éponges	Sponges	1105	110.2	
25773	*Priapulus caudatus*	Priapulide	Priapulid	1	< 0.1	2
84303	*Pseudarchaster parelii*	Étoile de mer	Sea Star	5	0.1	11
85220	*Psilaster andromeda*	Étoile de mer	Sea Star	16	0.8	113
82905	*Psolus fabricii*	Psolus écarlate	Scarlet Psolus	2	< 0.1	2
82594	*Psolus phantapus*	Holothurie	Sea Cucumber	3	< 0.1	4
84610	*Pteraster militaris*	Étoile de mer	Sea Star	14	0.2	39
84611	*Pteraster pulvillus*	Étoile de mer	Sea Star	7	0.1	28
13053	*Ptychogena lactea*	Méduse	Jellyfish	47	0.9	1911
11017	*Radiella hemisphaerica*	Éponge	Sponge	2	0.1	10
26881	*Retepurella grimaldi*	Bryozoaires marins	Marine Bryozoans	1	< 0.1	
72111	*Rhachotropis aculeata*	Gammaride	Gammarid	17	0.1	229
45057	*Rossia* sp.	Sépioles	Bobtails	60	0.8	108
81.29	*Sabinea sarsi*	Crevette	Sars Shrimp	10	0.2	119
81.28	*Sabinea septemcarinata*	Crevette	Seventline Shrimp	29	1.3	663
81.27	*Sabinea* sp.	Crevette	Shrimp	1	< 0.1	
34931	*Scalbrottophon fabricii*	Murex	Murex	8	< 0.1	10
37113	*Scaphander punctostriatus*	Céphalaspide	Giant Canoe Bubble	27	0.2	139
81.19	*Sclerocrangon boreas*	Crevette de roche	Sculptured Shrimp	15	20.2	30842
20140	Scyphozoa	Scyphozoaires	Scyphozoans	19	10.2	1015
26.79	*Securiflustra securifrons*	Bryozoaires marins	Marine Bryozoans	19	< 0.1	62
80153	*Sergestes arcticus*	Crevette	Shrimp	20	0.1	140
80155	*Sergia robusta*	Sergestidé écarlate	Scarlet Sergestid	1	< 0.1	1
43512	*Serripes groenlandicus*	Cuque du Groenland	Greenland Smoothcockle	1	< 0.1	1
41911	*Similipecten greenlandicus*	Pétoncle	Greenland Glass-Scallop	19	< 0.1	25
19830	Sipuncula	Sipunculides	Sipunculids	13	0.1	28

STRAP* code	Scientific name	French name	English name	Occurrence	Weight (kg)	Number
8445	Solaster endeca	Soleil de mer pourpre	Purple Sunstar	6	0,3	7
8087	Spirontocaris liljeborgii	Bouc épineux	Friendly Blade Shrimp	25	0,6	343
8084	Spirontocaris sp.	Boucs	Blade Shrimps	5	< 0,1	
8085	Spirontocaris spinus	Bouc perroquet	Parrot Shrimp	29	0,5	391
1352	Staurophora mertensii	Méduse à croix blanche	Whitecross Jellyfish	19	0,9	52
7750	Stegocephalus inflatus	Gammaride	Gammarid	18	< 0,1	29
8515	Stephanasterias albula	Étoile de mer	Sea Star	3	< 0,1	10
2159	Stephanauge nexilis	Anémone de mer	Sea Anemone	17	0,9	139
2173	Stomphia coccinea	Anémone marbrée	Anemone	37	1,2	160
8363	Strongylocentrotus sp.	Oursins	Sea Urchins	55	35	2303
1112	Stylocordyla borealis	Éponge	Sponge	35	0,1	265
6776	Synoicum pulmonaria	Ascidie	Tunicate	1	< 0,1	1
6791	Syscenus infelix	Isopode	Isopod	57	0,4	275
1108	Tentorium semisuberites	Éponge	Sponge	5	< 0,1	25
3101	Terebratulina septentrionalis	Térébratule du Nord	Northern Lamp Shell	12	< 0,1	15
4498	Teredo navalis	Taret commun	Naval shipworm	1	< 0,1	12
6972	Themisto libellula	Hypéride	Hyperiid	2	< 0,1	22
1357	Thuiaria thuja	Hydrozoaire	Bottlebrush Hydroid	15	< 0,1	117
8516	Urasterias lincki	Étoile de mer	Sea Star	1	< 0,1	1
3460	Velutina velutina	Veloutée lisse	Smooth Lamellaria	1	< 0,1	1
4451	Xylophaga atlantica	Bivalve	Atlantic Woodeater	3	< 0,1	56
4074	Yoldia sp.	Bivalves	Bivalves	1	< 0,1	1
	Total	**Invertebrés**	**Invertebrates**		6 710	1 003 886
		Others				
9995		Déchets	Trash	190	107,6	
9970		Capsule de raie	Skate Egg	21	0,7	64

*: *STRAP code based in part on works of Akenhead LeGrow (1981) for vertebrates and Lilly (1982) for invertebrates, as well as works on predation by marine organisms by the region of Quebec.*

Appendix 3. Number of measured and weighed specimens and descriptive statistics for the length in 2015.

STRAP* code	Scientific name	Sampled number		Length (cm)				
		Length	Weight	Min	P1	Median	P99	Max
	Vertebrates							
90	*Amblyraja radiata*	1263	936	9,2	11,2	31,2	66,8	75,2
696	*Ammodytes* sp.	54	54	5,1	5,1	8,5	15,6	15,6
700	*Anarhichas lupus*	181	148	5,8	8,9	20,1	72,4	73,4
701	*Anarhichas minor*	10	10	41,5	41,5	80,15	95,4	95,4
718	*Anisarchus medius*	2	2	10,9	10,9	12,1	13,3	13,3
320	*Arctozenus risso*	1605	858	12,5	18,2	24,5	27,6	28,7
193	*Argentina silus*	23	23	10,6	10,6	24,2	38,7	38,7
811	*Artediellus atlanticus*	147	124	3,4	3,6	6,3	11,5	11,6
812	*Artediellus uncinatus*	127	111	4	4	5,7	8,3	8,4
838	*Aspidophoroides monopterygius*	290	212	5,2	6,1	12,5	15,6	16,2
102	*Bathyraja spinicauda*	3	3	53,4	53,4	85,6	128	128
451	*Boreogadus saida*	134	116	6	7,6	11,7	22	22,8
865	*Careproctus reinhardti*	19	19	4,9	4,9	10,6	13	13
27	*Centroscyllium fabricii*	634	302	13,8	15,2	38	63,3	65,9
150	*Clupea harengus*	1161	777	12,8	18,4	29,1	37,7	38,6
829	*Cottunculus microps*	1	1	5,9	5,9	5,9	5,9	5,9
721	*Cryptacanthodes maculatus*	9	9	24,9	24,9	68,1	85	85
849	*Cyclopterus lumpus*	75	75	3,8	3,8	18,9	39,5	39,5
461	*Enchelyopus cimbrius*	1421	669	5,1	10,6	19,6	28,6	31,2
711	*Eumesogrammus praecisus*	241	112	7,7	8,7	15	21,5	22,4
844	*Eumicrotremus spinosus*	352	232	2,3	2,6	5	12	13,5
845	*Eumicrotremus spinosus variabilis*	4	4	5,9	5,9	7	7,6	7,6
438	*Gadus morhua*	5792	2616	4,6	14,5	34,4	63,3	95
439	*Gadus ogac*	2	2	31,6	31,6	32,9	34,2	34,2
453	*Gaidropsarus* sp.	1	1	4,4	4,4	4,4	4,4	4,4
426	*Gasterosteus aculeatus*	14	14	6	6	6,7	8	8
890	*Glyptocephalus cynoglossus*	2417	1963	5,5	7,8	29,3	43,1	54
205	*Gonostomatidae*	1	1	7,5	7,5	7,5	7,5	7,5
746	*Gymnelus viridis*	23	23	8,3	8,3	13,3	18,8	18,8
823	*Gymnocanthus tricuspis*	207	120	5,7	7,8	17,6	25,8	28,2
797	*Helicolenus dactylopterus*	2	2	16,1	16,1	17,8	19,5	19,5
809	*Hemitripterus americanus*	3	3	20,6	20,6	32,1	35	35
889	*Hippoglossoides platessoides*	6467	2572	2,7	9,5	19,5	41,3	55,3
893	*Hippoglossus hippoglossus*	145	145	22,8	23	52,2	170	202
831	*Icelus bicornis*	7	7	4,9	4,9	5,3	7,9	7,9
832	*Icelus spatula*	60	51	3,3	3,3	7,4	12,2	12,2
836	*Leptagonus decagonus*	146	100	3,8	3,8	18,25	22,1	22,5
717	*Leptoclinus maculatus*	719	376	6,2	8,8	12,8	18	19,7
891	*Limanda ferruginea*	3	3	24,2	24,2	26,4	30,1	30,1
862	*Liparis gibbus*	28	28	3,5	3,5	15,65	24	24
966	*Lophius americanus*	11	11	31,7	31,7	62,6	86	86
716	*Lumpenus lampretaeformis*	301	208	13,2	14,1	27,5	40,7	45
750	*Lycenchelys paxillus*	1	1	17,6	17,6	17,6	17,6	17,6
752	*Lycenchelys verrillii*	12	12	9,5	9,5	11,8	12,6	12,6
727	*Lycodes esmarkii*	2	2	20,4	20,4	30,7	41	41
728	*Lycodes lavalaei*	101	90	6,1	7,6	34,7	61,9	62,1
733	*Lycodes polaris*	3	3	19,2	19,2	20,6	20,7	20,7
726	*Lycodes* sp.	13	9	7,1	7,1	22,5	42,7	42,7
734	*Lycodes terraenovae*	6	6	12	12	19,2	30,3	30,3
730	*Lycodes vahlii*	333	189	7,9	10,2	26,6	40,6	48,2
91	*Malacoraja senta*	780	652	8,2	8,9	13,8	59,9	62,9
187	*Mallotus villosus*	1019	577	7,2	9,2	14,8	18,1	19,1
441	*Melanogrammus aeglefinus*	10	10	29,7	29,7	32	46,2	46,2
745	*Melanostigma atlanticum*	599	323	4,4	5,4	11,2	13,9	14,5
449	*Merluccius bilinearis*	142	142	12,1	13,6	31,2	43,3	45
272	Myctophidae	160	123	5,2	5,2	13,9	16,5	17

STRAP* code	Scientific name	Sampled number		Length (cm)				
		Length	Weight	Min	P1**	Median	P99**	Max
271	Myctophiformes	1	1	11,7	11,7	11,7	11,7	11,7
819	*Myoxocephalus scorpius*	209	179	5	9,7	28,1	42	43,3
12	*Myxine glutinosa*	1830	830	7,5	22,2	35,8	48,6	54,1
368	*Nemichthys scolopaceus*	2	2	39,9	39,9	49,05	58,2	58,2
278	*Neoscopelus macrolepidotus*	6	6	7	7	11,7	18	18
478	*Nezumia bairdii*	1338	665	6,4	8,5	22,2	31,7	34,6
275	*Notoscopelus elongatus*	7	7	14	14	14,2	16,7	16,7
874	*Paraliparis calidus*	5	5	6,7	6,7	9,8	11,5	11,5
856	*Paraliparis copei*	14	14	8,3	8,3	10,4	12,4	12,4
15	*Petromyzon marinus*	1	1	18,9	18,9	18,9	18,9	18,9
444	*Phycis chesteri*	549	397	13,5	15,4	26,1	36,6	37,9
443	*Pollachius virens*	3	3	37,1	37,1	38,6	47,3	47,3
222	*Polyipnus clarus*	1	1	5,5	5,5	5,5	5,5	5,5
94	*Rajella fyllae*	1	1	45,8	45,8	45,8	45,8	45,8
892	*Reinhardtius hippoglossoides*	8169	4127	3,1	13,6	26,8	54	80,2
572	*Scomber scombrus*	243	223	6	6,2	9	15,5	36,6
398	*Scomberesox saurus*	1	1	31,9	31,9	31,9	31,9	31,9
793	*Sebastes norvegicus*	2	2	53,3	53,3	54,75	56,2	56,2
792	*Sebastes* sp.	14244	7526	4,5	7,7	17,7	42,7	48
710	*Stichaeus punctatus*	1	1	10,2	10,2	10,2	10,2	10,2
814	*Triglops murrayi*	439	264	5,7	6,5	10,7	17	17,4
837	*Ulcina olrikii*	26	26	4,9	4,9	8,2	9,2	9,2
447	*Urophycis tenuis*	1226	916	21,2	23,4	35,7	59	64,8
168	*Xenodermichthys copei*	2	2	16,5	16,5	16,6	16,7	16,7
	Invertebrates							
8040	*Acanthephyra pelagica*	2	0	1,326	1,326	2,364	3,402	3,402
8039	*Acanthephyra* sp.	2	0	2,266	2,266	2,268	2,27	2,27
8138	*Argis dentata*	889	0	0,539	0,819	1,651	2,319	2,98
8113	*Atlantopandalus propinqvus*	95	0	1,334	1,334	1,77	2,323	2,323
8213	*Chionoecetes opilio*	773	364	0,8	1	4,8	12,8	13,8
8075	*Eualus fabricii*	229	0	0,556	0,567	0,808	1,107	1,223
8081	*Eualus gaimardii belcheri*	1	0	1,358	1,358	1,358	1,358	1,358
8080	*Eualus gaimardii gaimardii*	101	0	0,707	0,711	1,015	1,326	1,414
8077	*Eualus macilentus*	287	0	0,546	0,615	1,008	1,332	1,338
8074	*Eualus* sp.	14	0	0,64	0,64	0,729	0,92	0,92
8217	*Hyas araneus*	210	116	0,4	0,5	1,35	7,1	7,7
8218	*Hyas coarctatus*	455	230	0,4	0,5	1,5	6,5	8
8028	*Hymenopenaeus debilis*	1	0	2,068	2,068	2,068	2,068	2,068
4753	*Illex illecebrosus*	2	2	16,1	16,1	17,15	18,2	18,2
8092	*Lebbeus groenlandicus*	226	0	0,58	0,61	1,309	2,198	2,394
8093	*Lebbeus polaris*	380	0	0,555	0,624	0,956	1,422	1,528
8196	*Lithodes maja*	121	107	1,8	3,1	8,6	11,5	11,5
8111	*Pandalus borealis*	27880	893	0,662	0,922	2,131	2,78	3,016
8112	*Pandalus montagui*	2775	0	0,606	0,791	1,347	2,078	2,281
8057	*Pasiphaea multidentata*	2360	0	0,6	1,016	2,378	2,912	3,272
8135	*Pontophilus norvegicus*	979	0	0,569	0,82	1,244	1,659	1,745
8129	*Sabinea sarsii*	69	0	0,621	0,621	1,19	1,579	1,579
8128	*Sabinea septemcarinata*	532	0	0,59	0,672	1,157	1,751	1,896
8119	*Sclerocrangon boreas*	415	0	0,701	0,823	1,485	2,774	2,993
8033	*Sergestes arcticus*	89	0	1,122	1,122	1,469	2,045	2,045
8035	*Sergia robusta*	1	0	0,963	0,963	0,963	0,963	0,963
8087	*Spirontocaris lilljeborgii*	89	0	0,68	0,68	1,143	1,502	1,502
8085	*Spirontocaris spinus*	175	0	0,467	0,55	0,915	1,6	1,617

** STRAP code based in part on works of Akenhead LeGrow (1981) for vertebrates and Lilly (1982) for invertebrates, as well as works on predation by marine organisms by the region of Quebec.*

*** P1 : 1st percentile P99 : 99th percentile*